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The *Bulletin* serves as a means of communication between the Department of Defense, its authorized agencies, defense contractors and other business interests. It provides guidance to industry concerning official DOD policies, programs and projects and seeks to stimulate thought on the part of the Defense-Industry team in solving problems allied to the defense effort.

Suggestions from industry representatives concerning possible topics for future issues are welcomed and should be forwarded to the Editor at the address shown below.

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FEATURES

DEPARTMENTS

Shown on the cover are three stages in a successful launch of an Athena missile. The Athena program is just one facet of the multi-missioned Space and Missiles Systems Organization (SAMSO) of the Air Force Systems Command, whose story is featured in this issue.

Working Partner with Industry

Lieutenant General John W. O'Neill, USAF

Few Air Force or Defense Department elements have as close and vital a working partnership with industry as the Air Force Systems Command's Space and Missile Systems Organization (SAMSO). SAMSO's beginnings date back to the now historic era of the mid–1950s, when the Air Force and industry were pooling brainpower, experience and energies in a top priority race to develop the first U.S. ballistic missile capability. The alliance has remained exceptionally strong and fruitful in the years since—through the birth of the space age and into today's new generations of missiles and of operational, as well as purely experimental, space systems.

As presently constituted, SAMSO was established on July 1, 1967, from elements of the former Space and Ballistic Systems Divisions of the Air Force Systems Command. It is the direct descendent of the original Western Development Division, set up in a Los Angeles schoolhouse in 1954 to begin the formidable task of developing and intercontinental ballistic missile (ICBM).

SAMSO is the management agency for planning, development, testing and acquisition of all Air Force space and ballistic missile systems. Headquarters of the organization is at Los Angeles Air Force Station. Missile elements are located at Norton AFB, San Bernardino; test wings at the Eastern and Western Test Ranges; missile site activation task forces at a number of bases in the northwestern and central United States; and space tracking facilities all over the world.

Our annual budget is more than $2.5 billion. We have a work force of approximately 7,000 people, military and civilian, worldwide. Our mission responsibilities include management of 19 major missile and space systems involving 53 major contractors; 1,100 other contractors; and hundreds of first- and second-tier subcontractors and suppliers in 28 states. We have estimated that something like 300,000 people in industry throughout the country contribute full-time efforts to SAMSO programs.

Strategic Missile Responsibilities

About half of the SAMSO budget is applied to strategic missile programs. The present U.S. deterrent missile force consists of 54 Titan ICBMs, 1,000 Minuteman missiles, and 656 submarine-based Polaris systems. These, with approximately 600 long-range bombers, constitute the nation's strategic power—our long-range retaliatory force.

We know that both the Soviets and Communist China are devoting exceptional efforts to development of their own nuclear strategic power. Secretary of Defense Laird has stated that the Soviet Union, with a gross national product of only one-half that of the United States, is spending $3 for every $2 spent by the United States on offensive strategic weapons. This year Russia will achieve the same number of intercontinental missiles in hardened silos as the United States now possesses. Secretary Laird has further stated that he believes the Red Chinese will have a long-range ICBM "in the next 18 months" (by mid–1970).

The goal of the SAMSO missile mission is to ensure that the U.S. missile force retains that edge over these known developments which spells deterrence, and the greatest measure of security which military strength can give us. We must continually develop and update our weapon systems in consonance with our national

strategy; with the abilities and intentions of potential enemies, as we understand these; and with the evolving state of the art as it offers new opportunities for improved weapon capabilities.

A Force Modification Program, to replace the Minuteman I systems already deployed in the field with the greatly improved Minuteman II system, is currently underway. This entails carefully time-phased modification of the ground sites for the first five of our six Minuteman wings. Wing VI was originally activated with Minuteman II systems. The program will be completed in the early 1970s.

At the same time development and testing of the Minuteman III is proceeding. Minuteman III is an advanced version, so greatly improved in its capabilities that it is as different from the original Minuteman I as the F–111 aircraft is from the P–51 of World War II fame. Among its major advances are greater power, improved guidance, and the capability for launch of multiple independent re-entry vehicles (MIRVs) upon a single missile.

The Minuteman is an example of the associate contractor approach to procurement and production, one successful innovation of the missile program. The Boeing Co. is the integrating contractor, handling assembly and test. TRW performs systems engineering and technical direction of the programs. Sylvania Electronics Systems is responsible for ground electronics for Minuteman III. Autonetics Division of North American Rockwell Corp. contributes guidance. Aerojet General, Thiokol and Hercules provide propulsion. AVCO and General Electric supply re-entry vehicles. It has proved to be an exceptionally able team in the development and production of this ballistic system, which has become the mainstay of our deterrent missile force.

In planning beyond the Minuteman III, SAMSO is studying the possibility of larger vehicles that will carry heavier payloads, and increased hardening of both missile and launch sites. Extensive studies and tests in a hard-rock silo development program, for instance, have investigated the feasibility of housing our missiles in silos cut into solid rock or constructed of special concrete harder than granite. Such basing could substantially improve the ability of our deterrent missile force to survive enemy attack. This and other advanced planning concepts are geared into work being done to advance the state of the art, and to provide building blocks for future missiles of improved capabilities and greater effectiveness.

Re-entry System Research

Another major effort on the missile side of the house is the advanced ballistic re-entry system (ABRES) program. One important characteristic of ballistic missiles is the fact that great improvements in mission effectiveness can be obtained by improving the re-entry system alone, the business end of the missile—much as one might put a new and better nib on a pen. Therefore, research and development effort in re-entry systems promises proportionately high returns for the investment.

The Air Force is the executive agent for the development of all re-entry vehicles for the Defense Department, and the Army and Navy work with SAMSO in the endeavor. Over $100 million a year is spent to study and test designs and techniques that will get our re-entry systems safely past both the natural hazards which they must survive on re-entering the atmosphere, and the enemy's defenses aimed at intercepting and destroying them before they can reach their targets.

A four-stage, subscale test missile, the Athena, has been developed for relatively low-cost testing of advanced re-entry system designs and concepts. Payloads are launched from Green River, Utah, over a 470–mile inland test range to impact within the Army's heavily instrumented White Sands Missile Range in New Mexico. Full-scale re-entry system tests are also made, using Atlas boosters, over the Western Test Range out of Vandenberg AFB, Calif., to the Kwajalein Atoll area of the Pacific.

The progress made in re-entry systems technology—one of the critical unknowns at the beginning of the missile programs—ranks among the most heartening proofs of the research and development capabilities of American industry.

Space Programs

Missile programs are, of course, only a part of the total SAMSO mission. The other half of our budget and our energies is devoted to work in military space systems. In 1961, the Air Force became the executive agent of the Defense Department for the development of a military space capability. The bulk of this responsibility rests with SAMSO.

Our efforts have been concentrated on three specific approaches:

- Development of a varied stable of space launch vehicles.
- Creation of a worldwide satellite control facility for tracking, servicing, commanding, controlling and recovering space systems.
- Development and launch of a number of space satellite systems, designed to probe the possibilities of accomplishing a variety of missions in space—nuclear detonation detection, communications, navigation, and others.

Stable of Boosters. The boosters are varied and extremely flexible in their potential. Most of them are adaptations of ballistic missiles originally designed as weapon systems—the Thor, Atlas, Titan and Minuteman. They can place in near-earth orbit (100-mile altitude) spacecraft varying in weight from 300 pounds to as

Lieutenant General John W. O'Neill, USAF, became Vice Commander of the Air Force Systems Command on Sept. 1, 1969. At the time this article was written, he was Commander of the AFSC Space and Missile Organization, and prior to that commanded the Electronic Systems Division of AFSC. General O'Neill earned a bachelors degree from Boston University, a masters degree from the University of Pittsburgh, and is a graduate of the Air War College.

much as 25,000 pounds. They can put payloads weighing up to 2,000 pounds into synchronous orbit (22,000 miles altitude). The Titan IIIC, latest and most powerful of the boosters to join the inventory, has an upper-stage restart capability and has put as many as eight separate payloads into individual orbits in a single launch.

The record of reliability of our launch systems has improved steadily. For the last five years, the launch success score has been over 90 percent.

Satellite Control Facility. In the second major approach to space system responsibilities, SAMSO has developed a space tracking control and recovery network, designated the Air Force Satellite Control Facility. Its worldwide network is operational around the clock receiving data from our spacecraft, issuing instructions to them, checking regularly on their operational health, and de-orbiting and recovering them as required.

The Satellite Control Facility, with its main control center at Sunnyvale, Calif., currently services between 40 and 50 space systems daily. Its workload has risen rapidly over the past five years, as increasing numbers of long-life satellites have been put into orbit.

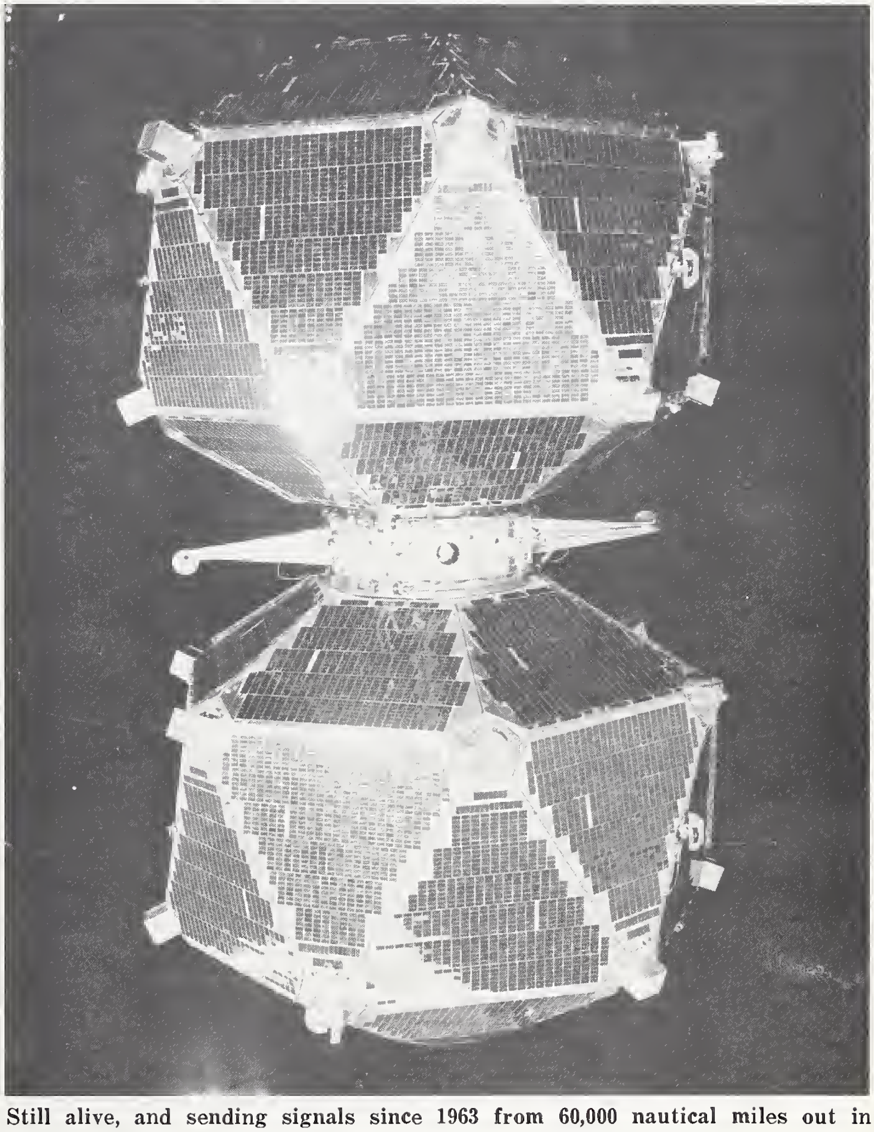
Spacecraft. In the third area of major space program activity, a wide variety of satellites have been developed and launched for certain types of military missions which can be most advantageously performed in the space environment.

The oldest of these satellites still in orbit is the VELA nuclear detonation detection satellite, developed to monitor the Nuclear Test Ban Treaty. The first pair of VELAs was launched in 1963; 10 have now been put into orbit. The last pair of VELAs was launched July 23, 1969.

Octahedron-shaped systems, the latest models of which weigh about 735 pounds, the VELAs operate in random orbit at a altitude of 60,000 nautical miles, circling the Earth every 108 hours. They can detect nuclear events both on the surface of the Earth and far out into deep space. In addition to successfully performing their primary nuclear detection mission, the VELAs have provided from their lofty orbit valuable information on the solar wind characteristics and a variety of other scientific data, including surveys of radiation for the manned space flights.

The VELAs, produced by TRW Systems, were trail blazers in incentive contracting of space systems and continue to be one of the most noteworthy examples of the benefits which can accrue to both Government and industry from incentive procurement. Originally designed for a life expectancy of six months and launched in 1963, the first two VELAs are still functional. TRW has earned all of the incentive profits in the contract package. Because of the endurance and reliability of the earlier systems, the Air Force has been able to stretch out the time interval between subsequent launches and, thus, accomplish very substantial state-of-the-art improvements from one pair of VELAs to the next.

Another of our satellite programs—and one of our most prolific—is the Initial Defense Communications Satellite System (IDCSS) effort. These systems provide global strategic communications, excepting only the areas of the North and South Poles. They are under the direction and control of the Defense Communications Agency. Twenty-seven of the spacecraft have been placed in a near-synchronous equatorial orbit in a series of multiple launches by the Titan IIIC. Getting the satellites into their individual orbits was one of the most sophisticated space maneuvers attempted to date. Twenty-four of the systems are now functional and giving excellent service, chiefly between the United States and Southeast Asia. The systems are programmed to turn them-



Still alive, and sending signals since 1963 from 60,000 nautical miles out in space, the VELA nuclear detonation detection satellites monitor the Nuclear Test Ban Treaty. Launched in pairs, there are now 10 VELA satellites in near-circular orbit.

SPACE AND MISSILE SYSTEMS ORGANIZATION

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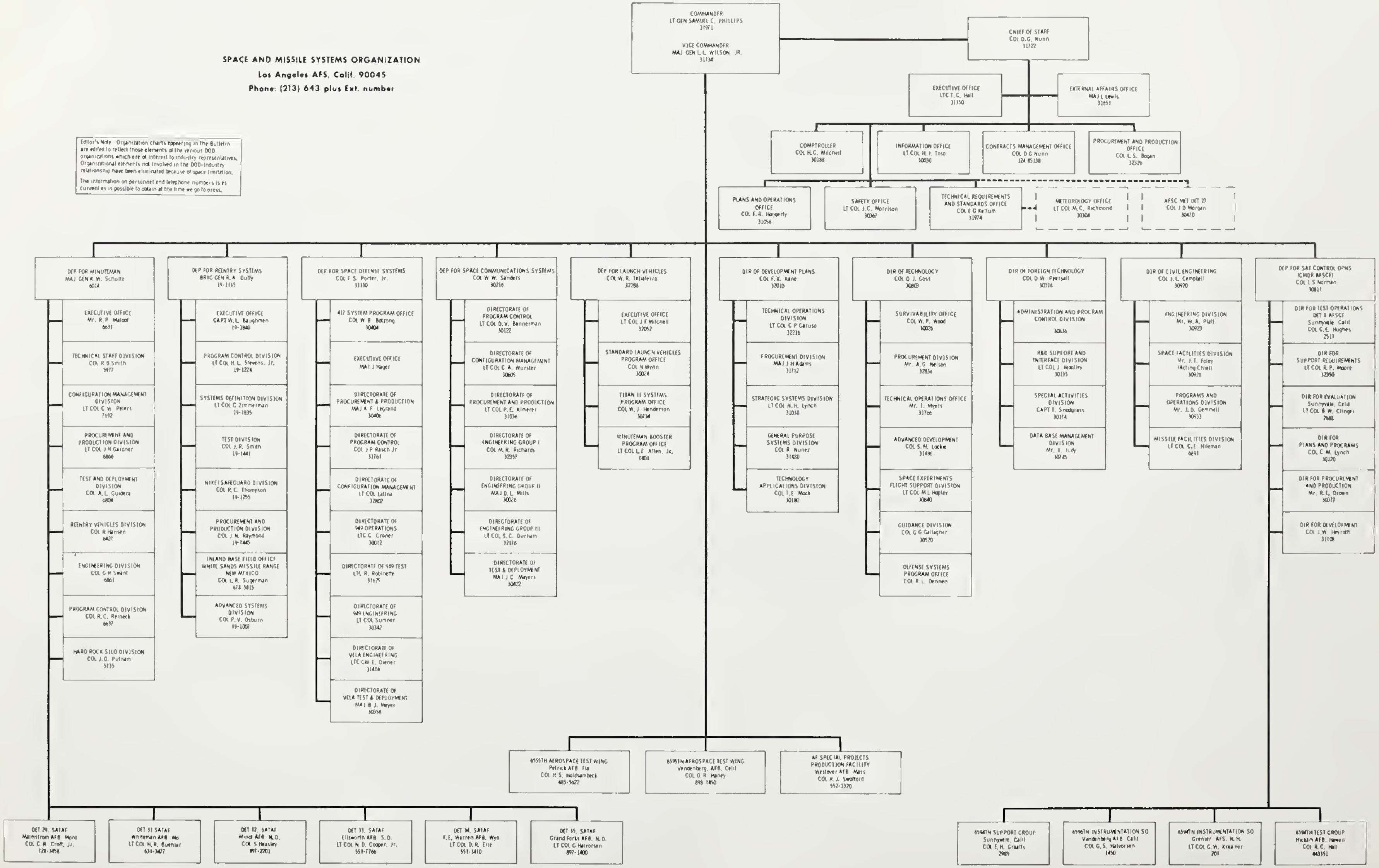
Editor's Note Organization charts appearing in the Bulletin are edited to reflect those elements of the various DOD organizations which are of interest to industry representatives. Organizational elements not involved in the DOD-industry relationship have been eliminated because of space limitation.

The information on personnel and telephone numbers is as current as is possible to obtain at the time we go to press.



selves off at the end of six years, by which time we plan to have orbited a greatly improved system with much more power and enormously increased capabilities.

In the meantime, development is proceeding on two communication systems very similar to the IDCSS, but with more specialized area coverage. One is being developed for the United Kingdom and the other for NATO. They will be launched by the end of this year.

Still another SAMSO program, designed to tap in on the natural advantages which space offers for communications, is the Tactical Communications Satellite (TACSAT I). This is a tri-Service experimental program which enables establishment of always critically needed communications in the field between users having very small receivers—in airplanes, tanks, jeeps, ships and even in the backpack of the foot soldier. This is made possible by concentrating a very large amount of power in the spacecraft itself to compensate for the low power of the small ground stations.

The first TACSAT I to date, developed and produced by Hughes Aircraft Co., was successfully launched into synchronous orbit (22,300 miles) by Titan IIIC on Feb. 9, 1969. Two stories tall, weighing about 1,600 pounds, it is the largest communications satellite yet orbited by the Free World.

We believe that this satellite foreshadows major improvements in tactical communications. It can be placed in space in a stationary position to provide coverage over specific areas of interest. To tactical action in such areas, this satellite can bring a communications capacity about equivalent to that of 10,000 two-way telephone channels. It can be moved from one point to another, and is designed for a service lifetime of about five years.

Advanced Planning

Another major mission responsibility of SAMSO is advanced planning for future space and missile developments. We conduct exhaustive studies, analyses and comparative assessments of feasible future missile and space systems, examined in the light of the evolving state of the art, knowledge of the capabilities or intentions of potential enemies, and changes in our own strategy or mission requirements. Alternatives, with all supporting data,

Shown, in artist's concept, resting in their metal container atop the transtage moments after the metal nose fairing has fallen away from the Titan IIIC space booster, are eight Initial Defense Communications System satellites (IDCSS) boosted into orbit. There are now 24 functioning IDCSS satellites spaced around the Earth, providing the first U. S. military communication system in space.

are presented through channels to the top decision makers, military and civilian. Based on this information, they choose the programs to be funded and carried forward.

Many of these projects are classified. Typical of those which can be mentioned briefly here are studies on the next generation ICBM, on further hardening of Minuteman missile silos, on penetration aids for advanced reentry systems, and on options for defenses against ballistic missiles.

Since launch costs are the major expenditure, and a limiting factor in space operations, a number of investigations of possible economies in this area are underway at SAMSO. Among these are studies on reusable boosters and on a minimum cost design launch vehicle called Big Dumb Booster (BDB). BDB features extremely simple design and relatively low-cost materials, as opposed to the more sophisticated subsystems and costly, lightweight alloys that have become traditional in space boosters.

Space systems and equipments presently under consideration include a navigation satellite system which could be used by aircraft, ships, submarines and land forces; a multi-purpose reusable spacecraft, manned or unmanned, which could be launched like a space vehicle, and upon re-entry into the atmosphere could be maneu-

(*Continued on page 28*)

DOD Announces Additional FY 1970 Expenditure Cut

On August 21, Secretary of Defense Melvin R. Laird announced preparations for cuts of up to $3 billion in FY 1970 defense expenditures. The cutbacks, he said, were required by Congressional limitations placed on Federal expenditures for the fiscal year ending June 30, 1970, anticipated budget cuts by Congress, and the economic needs of the country.

"Our problem is compounded by the fact that it now appears likely that the Defense Department budget will not be voted by the Congress before late this year—roughly halfway into FY 1970 . . .," Laird said.

The reductions announced were in addition to the $1.1 billion expenditure and $3.1 billion appropriations cuts reflected in the revised FY 1970 budget. The new reductions will reduce FY 1970 expenditures by more than $1.5 billion. As these reductions are taken, the funds will be reserved, pending final Congressional action.

The cuts, as outlined by Secretary Laird, include the previously announced reductions in the Cheyenne and Manned Orbiting Laboratory programs, as well as the announced initial redeployments of troops from South Vietnam.

"We will be required, in order to make these savings, to lay up ships, reduce flying hours, close some bases, and reduce military and civilian manpower," the Defense Secretary said.

The proposed actions, by Service, are:

- The Army will reduce its FY 1970 non-Southeast Asia operations, maintenance and training by approximately $500 million. The Army, as part of this program, previously had announced plans to inactivate the 9th Infantry Division.
- The Navy will inactivate more than 100 ships.
- The Air Force will reduce its non-Southeast Asia training by 300,000 flying hours for the remainder of this fiscal year.

Total reductions in manpower were announced at 100,000 military and 50,000 civilian personnel, to be achieved by the end of the fiscal year. The decision on which bases would be closed has not been made; announcement will be made at a later date.

The Secretary emphasized the effect the cuts would have on the U.S. military's defense posture: "In summary, we are going to make the cuts in military spending. We will strive to alleviate to the maximum extent possible the adverse impact of these reductions. But it is clear that our defense readiness will be weakened."

On August 22, in a subsequent statement, Secretary of the Navy John J. Chafee announced details on the Navy's actions in compliance with Secretary Laird's budget reductions.

Of the more than 100 ships to be ultimately retired, 76 were identified by Secretary Chafee. The major ships included 50 combatants; among these are the battleship USS New Jersey, the heavy cruiser USS Canberra, the antisubmarine aircraft carriers USS Bennington and USS Kearsarge, and the amphibious assault ships USS Boxer, USS Princeton and USS Valley Forge. The balance of the list included destroyers and frigates, submarines, additional amphibious warfare ships, auxiliaries, and the mine countermeasure ship USS Ozark.

The average age of the ships listed is 24.6 years, and 52 are more than 25 years old. The ships will either be decommissioned and placed in mothballs, will replace older ships for naval reserve use, or will be scrapped. Retirement actions on the ships listed were expected within three months. Other ship reductions will be announced as details are worked out.

As a result of the reduction in ships, the manpower of the Navy will ultimately be reduced by about 72,000. Further savings are expected from reductions in civilian personnel, and in reductions at shore installations.

The loss of the ships is expected to be offset to a partial degree by new ships under construction and fleet modernization conversions, according to Secretary Chafee.

Air-Ground Casualty Recovery Aim of Army

A new high-speed, air-ground pickup system for evacuating injured personnel from hostile or inaccessible areas is being tested by the Army. The system is designed to "snatch" casualties from isolated areas with minimum possible risk for the rescuing aircraft.

Para-delivered to the recovery area, the system consists of a container into which the casualty is placed, and a tethered helium balloon. Pickup is made by an aircraft engaging the tether with a nose-mounted skyhook anchor system. The container, with casualty, is then pulled into the air and retrieved into the aircraft.

The Army Combat Developments Command, Fort Belvoir, Va., has specified that the container be aerodynamically "flyable" to prevent tumbling while being towed by the aircraft. Additionally, it must be capable of safely transferring ambulatory patients requiring extensive medical care, and be buoyant.

The system would prove valuable, according to the Army, in counterinsurgency situations, where heliports or similar areas would be impractical to build, or where conventional medical evacuation would be impossible.

USAF 666A Office Moved

The Air Force Avionics Laboratory's 666A Advanced Development Program Office has been relocated from Holloman AFB, N.M., to laboratory headquarters, Wright-Patterson AFB, Ohio.

The office is responsible for the development and flight testing of advanced aircraft navigation systems. Current efforts include precise inertial systems, such as the gimbaled electrostatic aircraft navigator, and integrated systems employing Doppler inertial and LORAN sensors.

Program manager is Major John H. Dean.

FROM THE SPEAKERS ROSTRUM

The Defense Budget and American National Security

Hon. Melvin R. Laird
Secretary of Defense

Excerpt from address by Hon. Melvin R. Laird, Secretary of Defense, before the National Convention of the American Legion, Atlanta, Ga., Aug. 26, 1969.

As your keynoter this afternoon, I want to talk to you about national defense and, in particular, about the hard choices we face in the defense budget. We in the Defense Department recognize that the American economy, bountiful though it is, is not a bottomless well. There are limits to what it can produce. We recognize, too, that, important as it is to provide for the security of the nation from external dangers, there are other urgent tasks before the nation for which additional resources must be allocated in both the public and private sectors of our economy.

That economy must continue to grow so as to make available more consumer goods and an expansion of plants and equipment. Our cities must be made more livable. Schools must be improved. Crime must be reduced. The poor must be provided for and, in all possible cases, equipped to provide for themselves. Pollution of air and water must be curbed. Transportation must be modernized. Health facilities and personnel must be expanded.

The list is long and growing. Progress toward these goals requires capital, labor, time—and the attention and energies of all of us.

Since there are limits to our resources, we as a people have to make choices. In particular, the President and the Congress have to make basic and difficult decisions about how many of a limited number of dollars will be devoted to each of the aims of the national Government, and how many will be left for state and local governments and the private sector to spend as they choose.

I can assure you that the Defense Department is deeply conscious of the taxpayer's burden and of the importance of the domestic needs that lead to claims for more federal spending for non-defense purposes. We are determined to keep defense spending down and to reduce it wherever possible, as long as we can do so without imprudently weakening our ability to meet our defense needs.

Most of the critics of military spending, of course, do not want to weaken our defense posture. Most critics feel that the defense budget is oversized and wasteful—a judgment they make principally because the Defense Department spends so large a part of our national government's budget. Our defense budgets, in absolute amounts, are large—but so are our responsibilities. Defense receives about 41 cents of every dollar disbursed from Washington, and the share allocated to defense has been shrinking. Defense expenditures in 1969 were less than 9 percent of our Gross National Product. Next year they will be lower, both in absolute amounts and as a percentage of the output of the economy.

We in the Defense Department share the objectives of our critics—we, too, want to achieve greater efficiency; we, too, are striving for a reduced level of defense spending.

Let me go a step further. We agree with our critics not only on objectives but also on the fact that there is room for additional substantial savings within the defense budget. The nub of the problem, however, is this: How best can we increase the efficiency of the Defense Department and operate with the lowest feasible defense budget without impairing national security in the process?

If our primary objective is to reduce the level of defense spending no matter what the consequences then, obviously, further substantial spending cuts could be effected immediately. But that course would be irresponsible.

We cannot take imprudent risks that the American people will not have the protection they need when they need it. As Legionnaires, you know as well as any citizens in this country the vital need for maintaining a strong defense posture. Those of you who have known the ravages of war understand better than anyone else the importance of preventing war. That has been my overriding concern and my number one priority since assuming the office of Secretary of Defense.

Reappraising the Defense Posture

So what we have to do in reappraising and adjusting our defense budget is to insure that any adjustments we make for the purpose of saving money or eliminating waste do not at the same time cut into the muscle of our needed preparedness and capability.

Let us not be blind to the unpleasant facts of life in the world about us. We are still engaged in a war. And, although I hope that we can continue steadily to reduce the number of American troops in Vietnam, there are more than 500,000 of our men there today. I will resist any budget cuts that could add to American casualties in Vietnam.

Let us not be blind to threats to

peace in Korea or in other trouble spots in the world where American military forces maintain a vigil.

Let us not be blind to other potential dangers to our country that may be magnified and intensified if we fail to maintain military strength at a realistic level.

We shall strive to make the years ahead an era of negotiation rather than confrontation with the Soviet Union. We shall try to reduce the danger of armed conflict by adequately safeguarded agreements on arms limitation.

Until such agreements are concluded, however, it would be folly to disarm unilaterally or to permit a general weakening of our military strength. And, in determining the level of military strength appropriate for the United States, we cannot ignore what is going on in the Soviet Union.

Since in the last analysis the American people will determine the size and the shape of our defense forces, I think it important that the people know the facts required to make an informed decision.

It is important that they know that the Soviet Union right now is devoting greater effort than the United States to strategic offensive and defensive forces.

On a dollar basis in 1968, the Soviet Union spent approximately two dollars for every one dollar expended by the United States on strategic offensive and defensive forces.

Since 1965, when the United States began a substantial increase in military spending to support combat forces in Vietnam, Soviet expenditures have risen rapidly for a different purpose—the strengthening of strategic forces. In 1968, Soviet spending for strategic forces was about 30 percent higher than it was in 1965, whereas U.S. spending for such forces has remained relatively stable.

I do not want the import of these facts to be misunderstood. Our overall military capability today, together with the effort we have programmed in our defense planning, provides sufficient protection to the nation for the immediate future. But, if we project the trends which I have pointed out on beyond the next few years, doubts about our future security arise.

FY 1970 Budget Revision

In April, the Nixon Administration sent to the Congress a revised budget that was $3.1 billion lower than the Johnson Administration request in appropriations and $1.1 billion lower in actual spending.

That in itself was a difficult amount to squeeze out of the defense budget—not because the whole budget consists of muscle, but because getting the fat out without weakening the muscle is a function of such things as time and organizational change whose impact cannot be fully felt in the year in which it is undertaken.

The Chairman of the House Appropriations Committee has stated publicly that his committee will cut at least $5 billion from the appropriations request now pending before Congress. He alerted me to the fact that the current fiscal year is running and that action should be taken now to cut back defense programs.

In response to Congressional pressure, I announced last week that the Defense Department is preparing to cut spending this year by an additional $3 billion. Even these cuts do not satisfy some critics who impatiently demand additional major reductions in the level of spending this fiscal year.

These critics are urging a very dangerous course. If we are forced by Congressional action to make such additional cuts, the end result would be counterproductive. Rather than achieving real and lasting savings, we could instead be producing greater inefficiency, higher long-term costs, and greater problems than already exist in such intangibles as morale and personnel efficiency. We could, in short, reduce our defense readiness both for the short term and the long term, while bringing about only short-lived dollar savings.

Let me outline briefly for you precisely what the problem is. The budget proposed to the Congress in January 1969, by the Johnson Administration, called for $79 billion in defense spending.

The budget with which the Nixon Administration started was, in the eyes of the Services and the Joint Chiefs of Staff, an austere budget, since their initial requests totalled more than $100 billion. Now let me divide this reduced amount of $79 billion into several categories, to give you a better idea of the problems we face.

First of all, about $25 billion of that $79 billion represents the special cost of supporting our combat operations in Southeast Asia. This can be reduced only as a result of national policy decisions which reduce the level of our effort, such as the 25,000 troop redeployment announced by the President at Midway.

A little less than $3 billion represents payments to retired military personnel, fixed by law.

Southeast Asia costs and retired pay add to nearly $28 billion—well over one-third of our spending total.

This leaves $51 billion of that Johnson budget. About $8 billion is for strategic forces—for intercontinental ballistic missiles, Polaris submarines, bombers, and defense systems which are the backbone of our nuclear deterrent. Even if we adopted the posture advocated by the severest critics of defense programs, we would not make a major dent in that $8 billion for the current fiscal year. The recent antiballistic missile (ABM) debate, for example, did not significantly involve 1970 spending.

Another $6 billion is for research and development, aside from strategic forces and special Southeast Asia items. This is the part of our effort that provides our military strength for the future. Without adequate research and development, the American military in the future will find itself outmaneuvered, outgunned and overmatched. The Soviets are certainly aware of the critical importance of research and development. I recognize that this part of our program is a tempting target for budget cutters. It is an area where cuts can be made today without an immediate and apparent degradation of our forces. But, for the long run, nothing could be more detrimental than to neglect our research and development needs.

To complete the total, there are two remaining categories of defense spending. Our general purpose forces—aside from Southeast Asia—accounted for $22 billion of that Johnson budget total. This covers our Army and Marine divisions; our Naval forces—attack carriers, antisubmarine warfare forces, amphibious forces, and others; and Air Force tactical aircraft. Also included here are

our worldwide intelligence and communications systems; airlift and sealift; and our National Guard and Reserve forces. This $22 billion, in short, covers all the muscle we have, aside from the forces in Southeast Asia and the strategic forces that provide our nuclear deterrent.

Finally, the Johnson budget included about $15 billion for administration and support. This category covers our large training establishment; medical and hospital facilities; supply systems; the maintenance and rebuilding of weapons; and the general overhead of the Defense Department. These activities, of course, are essential to the success of all the programs of the department.

It is in the last two categories of the budget—our general purpose forces outside Southeast Asia, and the area of administration and support—that we must look for budgetary cutbacks. These two categories came to $37 billion in spending in the Johnson budget. We are now making preparations to cut $4.1 billion from the spending level in the Johnson budget, and most of this cut will have to come from these areas.

Now, let me introduce one further thought. We have been talking about *spending*—and about one-third of what we *spend* this year results from contracts in prior years. It is the payment now coming due on bills contracted in the past by earlier Administrations.

This, in a nutshell, is our problem: The programs that we can regard as serious candidates for immediate spending cutbacks comprise well under half of our budget—and even for these, a third of the spending is fixed by prior-year contracts. Thus, the planned spending cutbacks we have announced amount to 15 to 20 percent or more of the expenditures that are really subject to reduction at this time.

New Budget Cutbacks

[On August 21] I announced some of the actions we feel constrained to take as a result of the cuts Congress is expected to make in the Defense Department budget this year.

In order to make short-term savings, savings that would have a dollar impact in FY 1970, we have to lay up more than 100 ships, reduce flying operations by 300,000 hours, close some bases, and reduce military and civilian manpower probably by more than 150,000 before the fiscal year ends 10 months from now.

The actions announced last week, taken together with other cuts made earlier in the year, would reduce defense spending by $4.1 billion in FY 1970.

When I announced our preparations to make reductions of this magnitude, I said that they will inevitably result in some weakening of our worldwide military posture.

I apologize for overwhelming you with numbers, but it is impossible to discuss the budget without getting into figures. Let me summarize the conclusions to which all these statistics lead:

- Because of the clear intention of of Congress to force a heavy cut in defense spending this year, I have announced our plans to make further reductions of up to $3 billion in addition to the $1.1 billion in spending we announced earlier in the year.
- I am proceeding now with these plans because any delay until Congress finally acts on defense appropriations would make it absolutely impossible to make required reductions in any orderly and efficient way. Acting now, we still are compelled to inflict hardship on many of our personnel, military and civilian, whose lives will be disrupted.
- The effect of these cuts is to increase the risks to which the American people are exposed. Any further major cuts for the present fiscal year would involve even greater risks and further disruptions.

Time and again in our past history our nation has paid a frightful price for allowing its Armed Forces to dwindle to levels that proved to be too low to discourage or to counter aggression. "Too little and too late" has been the epitaph of more than one great nation in human history. I am determined that it will not be ours.

To maintain the military strength needed in the years immediately ahead, however, vigorous support of this objective by the American people will be required. I shall do my best so to manage the Defense Department as to deserve and win that support.

You who have seen war at first hand know that national weakness is not the way to peace or to freedom. You who cherish peace and freedom know that they must be protected with a keen sword and a stout shield. Pledge with me to keep the national sword and shield ready until, in God's good time, all nations learn to live together in peace and brotherhood.

Planning for Strategic Deterrence in the 1970s

Address by Hon. Robert C. Seamans Jr., Secretary of the Air Force, at the Joint National Meeting of the American Astronautical Society and the Operations Research Society of America, Denver, Colo., June 17, 1969.

My subject is a topic currently receiving great attention throughout the country. The decisions we make today will determine our national posture in the middle and late 1970's. Many of our people are improperly fed, clothed, housed, and have insufficient education and medical attention. These deficiencies demand early action. Of this there can be no question and should be no lack of support, but there is a limit to the speed with which we can solve domestic problems, just as there is minimum time required for the development, procurement and deployment of new aeronautical and space systems.

We have been making progress domestically but not fast enough. We must accelerate our efforts if we are to achieve major advances by 1975. Some may feel that our priorities at home are so demanding that we should allocate most of our national resources to them, cutting back drastically our military developments. Let me assure them that if we unilaterally lower our defenses and if a nuclear war results, the problems of our present world will seem simple indeed in comparison.

Hon. Robert C. Seamans Jr.
Secretary of the Air Force

We all agree our goal is to reduce the risk of nuclear war. The question is how to achieve that goal. I believe we must maintain our ability to retaliate even after absorbing a surprise nuclear attack. This can be done by carefully planning our future forces and by seeking effective arms control agreements.

The Soviet Threat

In planning for a nuclear deterrence, we must begin by considering the strategic threat.

The Soviets have surpassed us in numbers of ICBMs and are still building both land-based missiles and ballistic missile submarines. Counting the ICBM sites that we know to be under construction, they have about twice as much missile payload as our own ICBM and Polaris force—payload that can be very threatening to us if an expanding force is converted to multiple warheads.

They now have more than 230 ICBMs of a very large type, the SS-9, which are operational or under construction. They have tested a three-warhead version of the SS-9. Each of the three vehicles had a payload equivalent to a five-megaton warhead. If we take no action and the Soviets continue their present rate of SS-9 deployment, they could have the capability of destroying most of our land-based missile force by the middle 1970s.

Those who suggest that this is just another missile gap scare, like that of 1960, are not familiar with the developments in our detection capability in the last 10 years. In 1960 we were making educated guesses. Today the Soviet missile strength that we announce has been clearly determined. There may be more that we have not found yet, but there is no doubt about those we have detected.

Our present generation of bombers will also be increasingly vulnerable. The new classes of Soviet missile submarines may be able to reduce the warning time of an attack and catch our aircraft on the ground. The rapidly improving Soviet air defenses will make it increasingly more difficult for our bombers to reach their targets.

As to the third part of our deterrent force, our Polaris submarines, Soviet antisubmarine work continues at a high level. Even if our submarines escape detection, an improved Soviet antiballistic missile (ABM) system may be able to handle both our land-based ICBMs that survive a missile attack and our sub-launched missiles.

The Soviets have deployed a long-range system of some 60 Galosh ABM missiles. They also have deployed the Tallinn belt of defensive missiles which are thought to be primarily anti-aircraft weapons for ABM defense.

They have now tested an improved ABM which can coast or "loiter" above the atmosphere, *i.e.*, it could be restarted at altitude and directed to specific targets. Those who doubt that one missile can hit another when both are traveling at high speed should remember that the ABM can carry large nuclear warheads, which can damage incoming missiles from a considerable distance in the upper reaches of the atmosphere.

We do not know the Soviet intentions, but their ABM sites, as well as several of their other weapons, raise certain questions. So far, their ABM deployments seem to be oriented toward city defense rather than protecting their deterrent weapons, as a retaliatory posture would dictate. In fact, they continue to maintain nearly 150 soft missile sites that, because of their vulnerability, seem useful primarily for first-strike purposes. The Soviet high missile payload seems unnecessary for deterrence, but useful for attacks against missiles in hard silos. Their Fractional Orbital Bombardment System also seems designed mainly for a minimum warning attack, since it gives up payload to achieve a low trajectory. They might hope to use this trajectory to avoid early radar detection

The Value of Safeguard

Some say that we cannot protect our people from the effects of nuclear war, but in a larger sense that is not correct. If we provide for deterrence by maintaining and protecting our forces, we reduce the probability of an enemy attack and increase the probability that our people will be safe. This underlies the President's decision to proceed with the Safeguard ABM system.

Over a year ago, Dr. Harold Brown, then Secretary of the Air Force, told the Stennis [Senate Armed Services] Committee that he supported the Sentinel system for defense of our cities against the Chinese Communists. He further stated that it might be desirable at some time in the future to deploy ABM defense for our land-based missile force.

There were three new factors that caused President Nixon to propose Safeguard—a system to provide defense for certain of our missile fields. The first factor was the Soviet buildup in missile payload, as a result of SS-9 deployment. The second was the improvement in missile accuracy. Our own recent missile tests have achieved a high degree of accuracy and we would be foolish to assume that the Soviets could not do as well. The combination of Soviet payload and accuracy will make our missile silos extremely vulnerable in the middle 1970s. The third factor was the slowdown in Chinese missile development which permitted us to defer a light ABM defense of our cities.

Last year the Air Force began development of a new missile silo to reduce Minuteman vulnerability in the 1970s. But as missile accuracy continues to improve, harder silos will not be enough. We may need ABM protection to ensure that a sufficient number of our missiles would survive an attack.

The Safeguard system will put the burden on the offense. It will make it more difficult for an attacker to equip his weapons with the penetration devices necessary for successful first strike.

Moreover, Safeguard should not contribute to the arms race. It will make it more difficult for the Soviets

to destroy our missile sites in a first-strike attack, but will have no chance of defending our cities against their retaliation if we should strike first. Thus, the Soviets would not need to expand their forces because of Safeguard unless they were planning a first strike.

The ABM program proposed by the President provides an orderly step-by-step plan that can be halted at an early level of deployment, if further expansion is not required for our security. It will actually strengthen our position in arms control negotiations, since the Soviets already have an ABM of their own and might not see any reason to limit that system if they felt the United States would not build one anyway.

Need for an Improved Manned Bomber

In view of the possible vulnerability of missiles, the United States has maintained both a missile force and a bomber force to ensure against unexpected Soviet developments affecting either one of the systems.

Those who critize the bomber as an obsolete system in the missile age are often the same people who refer to our alleged 4–to–1 superiority over the Soviets in individually targeted warheads. They do not seem to realize that the ratio would be nearly 1–to–1, with total payload running heavily against us, if it were not for our bomber force with its multiple weapons on each aircraft.

If our bombers are to continue to provide deterrence, they must be able to survive an attack and then penetrate the ever-improving Soviet defenses. The B–52 is still a good aircraft, but the prototype was flying in 1952 and the latest models were produced in 1962.

An advanced bomber will take advantage of the many improvements that have been made in airframe and engine design. It would have the short takeoff and landing capability needed for dispersal and the payload, structure and speed necessary for penetration.

Over the years, we should be able to do a better job of maintaining our deterrent, at less cost, if we develop a new bomber to replace the B–52. Fewer bombers will be required, since they would be more survivable and better able to penetrate than the present bomber force.

Use of Space for Strategic Deterrence

In terms of security, the space age presents dangers, but it also affords opportunities for increasing strategic stability.

The dangers stem primarily from weapons placed in orbit. It might be possible to trigger such weapons with very little warning, thus increasing the risk of surprise attack.

The major powers have recognized the dangers. Both the United States and the Soviet Union have agreed to the Outer Space Treaty of 1967 which prohibits weapons in orbit. Both sides are watching closely to be sure there is no violation of the treaty.

Hopefully, the treaty will help us avoid the danger of weapons in orbit, while providing us opportunities for other sorts of military systems that could strengthen deterrence rather than weaken it. Any system that will give us better observation of enemy activities decreases the chances of a successful surprise attack.

Each generation of space vehicles will provide additional improvements in our ability to monitor enemy activities. We are now working on a satellite early warning system that would detect missiles as they are launched from land or sea. With the aid of such a warning system, a dispersed bomber force would be able to take off from its bases before the impact of enemy weapons, even if the time of flight of the latter were greatly reduced.

Planning for Arms Control

Arms control agreements are not incompatible with necessary improvements in our current forces. Both arms control and new weapon developments must be designed to maintain deterrence. Neither side can accept an arms control agreement unless it is certain that the proposed arms limitation will preserve its ability to retaliate against surprise attack.

Arms control agreements must structure opposing forces in a way that makes a first strike more difficult and retaliation more certain. This task should be eased by the growing realization that any effort to achieve a first strike will be countered decisively by the other side.

ABM systems that defend strategic weapons will facilitate arms control because they reduce the chance of an effective first strike. Both sides will be more likely to limit expansion of their offensive forces if the weapons they have are well protected.

Improved bomber forces also facilitate arms control. They provide insurance against the neutralization of missiles and, with their long time in flight, they do not constitute a first-strike threat against the enemy's weapons.

If no agreement can be reached to limit missile payload and ABM city defenses, then we may have to increase the size of our own offensive missile force to ensure that we can still retaliate. Unfortunately, this step might seem to the Soviets as preparations for a first strike from our side and, thus, add fuel to the arms race.

Rather than increasing our missile strength, it seems much better at this point to strengthen our deterrence with the initial deployment of the Safeguard ABM system.

The sort of balance we must plan involves a sufficient ABM system to protect one's deterrent weapons, but not enough to protect cities against the opponent's full retaliatory force.

This is a complex relationship of weapons, but one that does not preclude stability. If both sides favor arms control, both missile payload and ABM defenses can be fixed at levels consistent with deterrence.

However, an alignment of forces that can prevent war will not be reached or maintained, unless we are resolved to take whatever action is necessary to protect our own deterrent forces. If we refuse to maintain our deterrent, the Soviet Union will have no reason to stop short of a first-strike capability. At that point, any crisis situation would include the danger of a nuclear attack against the United States.

It is right for us to oppose war and to begrudge every fraction of our resources that must be allotted to the task of protecting man from man. Men should be mature enough and smart enough to live in peace with each other. I am certain that is the desire of many people here, in the Soviet Union, and throughout the world. If such an attitude takes hold, some day it will be impossible for national

leaders to take their people into wars of aggression. Nevertheless, we cannot put our heads in the sand and pretend that such a time has already arrived. We cannot let our ideals and our hopes for the future obscure the hard facts of today. We must maintain our defenses if we hope to survive to see our ideals become a reality.

In the final analysis, it is a matter of human will. We must make our scientific knowledge a handmaiden to man's hopes for a life which is both secure and beneficent. Eight years ago last month [May], President Kennedy recommended to the Congress that we commit this nation to a manned lunar landing and return in this decade. He saw the need for a program that would provide increased knowledge of our planetary environment. He saw the need for a program that would force advances in many technologies. He saw the need for a program to stretch the capabilities of many men and women. He saw the need for a dramatic program that would show ourselves and the world what the United States and, equally important, what man can accomplish when he proceeds with resolve. Next month [July], along with hundreds of million of men and women of all ages and all nationalities, I expect to participate vicariously in the fulfillment of our commitment to the lunar goal.

In conclusion, as we consider our plans for the next decade, I cannot do better than to quote President Kennedy at the anniversary convocation of the National Academy of Sciences in 1963:

> **. . . If Scientific discovery has not been an unalloyed blessing, if it has conferred on mankind the power not only to create, but also to annihilate, it has at the same time provided humanity with a supreme challenge and a supreme testing. If the challenge and the testing are too much for humanity, then we are doomed. But I believe that the future can be bright, and I believe the power of science and the responsibility of science have offered mankind a new opportunity not only for intellectual growth, but for moral discipline; not only for the acquisition of knowledge, but for the strengthening of our nerve and our will.**

The Future of the Air Force Space Program

Address by Brig. Gen. W. R. Hedrick Jr., USAF, Dir. of Space, Office of the Dep. Chief of Staff, Research and Development, Hq., U. S. Air Force, to the Joint National Meeting of the American Astronautical Society and the Operations Research Society of America, Denver, Colo., June, 20, 1969.

Our purpose of this joint meeting of participating societies is to discuss the planning needs and mission potential of the 1970s. Specifically, we should identify those most valuable space investment areas for the next decade.

There is not much question that, as a nation, we have a spectrum of very significant problems, most of which have been with us for quite some time. A number of these national problems are also pressing major military problems. One glance at the front page—at any page, for that matter—of any newspaper will certainly bear out my point. Unfortunately, in the hard, cold realism of the world in which we live, we cannot ignore one part of the spectrum of problems and work toward the solution of a separate group of problems. Progress toward the solution of our social and economic problems would be only an academic exercise if the security of our nation is not maintained.

In attempting to identify the military planning needs and mission potential of the 1970s, we should remember that due to long lead times and routine priorities, today's research will have limited influence on the immediate future of the Air Force because the early 1970s start in only six months.

Our first decade in space operations has primarily been devoted to the mastery of space. During this time of learning, we have developed some operational military systems. For example, DOD is now using 25 solar-powered satellites for reliable worldwide contact between the national authorities and our forces stationed overseas.

Plans for Coming Decade

In our second decade, we will continue to improve the operation of our military forces by developing additional space mission capabilities. However, our immediate future is primarily committed to evolution and improvement of past and current development programs, such as the Titan III, TACSATCOM (tactical satellite communications) and VELA.

Our planning for use of space in relation to other military capabilities will provide improved capabilities, such as the navigation satellite, methods for handling data generated by satellites, the relay via satellite of data from ground-based sensors, and the continued evaluation of new launch vehicles trying to achieve greater cost effectiveness.

Satellite Early Warning System Being Investigated

Of all the systems being investigated, probably the one most applicable to our continuing ability to deter a nuclear war will be an early warning system using the unique capabilities of a satellite for surveillance. The ability to detect missile launches from either land or water, and to relay this data to our decision makers, would do a great deal to preclude the possibility to surprise attack.

An enemy would have much less assurance that he could negate our strategic retaliatory forces if we have adequate warning of the attack. This will further deter a potential aggressor and help to preserve peace.

This, in turn, will provide the environment within which we can work toward solving our economic and social problems.

We are being extremely careful that our military and civilian space activities benefit fully from each other's investment and discoveries. We are working very diligently to prevent wasteful duplication of effort.

Close Cooperation Between NASA and DOD

We have been very successful in achieving close and beneficial cooperation between the National Aeronautic and Space Administration (NASA) and DOD. At the present time we have under evaluation a joint DOD/NASA space system. Of course, this system is in a very early planning stage. Such a system would, of necessity, have a transportation capability for military missions, as well as logistic support applicable to a NASA research space station or to the launch of both DOD and NASA payloads. Hence, the name Space Transportation System (STS). To provide for our future payload needs, we should examine large discretionary payloads that may be recovered and reused. Discretion suggests the substitution of propulsion capability for other missions—in place of cargo weight—as an option. The concept of reuse with the probable savings, shown in repeated studies, will receive primary attention.

The basic parameter, which will govern the choice between alternatives, is cost. Total system cost estimates are needed for research, development, test and evaluation (RDT&E) and operations, as well as the individual cost evaluations between reuse and expenditures of vehicle elements recovery method comparisons and boost concept analyses. The best possible economic studies, with emphasis on determining the cheapest among competing effective techniques, will remain as central factors in future decisions.

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Space Transportation System Needed in Future

Our near-term course consists of two steps. The first is the selection of an STS configuration concept to ensure that the capability for alternative missions, increased payloads, and a wider range of operational concepts receives attention.

Second, the design considerations for a future STS include:

- Keep the system reliable, yet simple.
- Accommodations and redundant systems should be contained in the STS for manned reliability and safety, but it should be designed for both manned and unmanned operational use.
- Large discretionary payloads should be considered.
- Design to launch and recover for reuse as much as possible—preferably all—of the total space vehicle.
- Spacecraft should have a night, all-weather landing capability.
- Subsonic cruise capability after re-entry, as well as an aerodynamic takeoff capability, are needed for development testing and ferrying to the launch site.
- STS design should be based on reusable features. The design should permit a simple inspection and servicing approach to refurbishment comparable, in concept, to turn-around of modern aircraft.
- Maximum performance at design operating conditions and, yet, good low-speed horizontal landing characteristics by using variable wing geometry should be included.
- Military bases, such as Edwards AFB, Calif., should be the operational landing sites.

I believe that the increasing need to have the kinds of capabilities that I have discussed will provide a positive answer to the question of the necessity for development.

In the same time period, a series of coordinated exploratory and advanced development programs will both improve existing technology and expand our knowledge in the direction of newer concepts. These specific steps will include presently identified projects, and work in areas of uncertainty resulting from the expanded analysis or recommendations by elements of the Air Force.

Potential Applications for STS

In closing, I would like to leave you with some specific thoughts on potential applications and design considerations for a future lifting spacecraft.

First, with a large discretionary payload capability, such a space transportation system could perform several missions including some perhaps unforeseen today. For a historical analogy, one can look back to the venerable workhorse of the mid-1930s which is still flying—the DC–3, or C–47, an aircraft whose many missions have ranged from cargo hauling to gun-carrying combat aircraft.

The more modern C–130 aircraft, too, has flown in many configurations—cargo, troop carrier, tanker, and as a gunship. A lifting spacecraft might indeed serve a similar purpose as a multi-mission vehicle—a C–47/C–130 type spacecraft with adaptability to changing mission requirements. As you can see, the Air Force has a marked interest in space transportation for future military missions.

As we spend this time identifying the most valuable space investment areas for the next decade, we should remember that space—like land, the sea and the atmosphere—is another medium that is available for our use. Like the water, the land and the air, space can be used for all of mankind's mutual benefit if we choose. However, the management and technical skills that permit us to operate in space have also allowed us to build weapons with destructive power beyond comprehension. Operations in space can either be used to break or keep the peace. The Defense Department efforts associated with space are to keep the peace and provide the environment within which our social and economic problems can be resolved.

Putting the Weapon in the Weapon System

Colonel Abner B. Martin, USAF

Significant technological advances in aircraft and air munitions have been realized during the past five years; however, under tactical conditions, the ordnance-laden aircraft is not as effective as it could and should be. One of the foremost reasons for inefficiency of the air-to-surface attack system has been the lack of stringent attention in the area of interfacing air munitions with aircraft.

Historically, primary emphasis has been placed on design of the basic airframe and its associated propulsion system, with secondary attention afforded to the integration of munitions which are essential in performing a successful mission. Spectacular improvements have been realized in avionic systems and in aircraft performance parameters (speed, maneuverability, rate of climb, endurance, etc.) of a clean wing aircraft. Several improvements have also been realized with respect to the terminal effectiveness of conventional ordnance but, paradoxically, the ability to deliver weapons accurately on target has not kept pace with the other technological advances.

Even more disturbing is the fact that serious aircraft/weapon compatibility problems will persist if aircraft and armament continue to be developed independently of one another. Aircraft performance constraints, such as those imposed by excessive drag of external stores, flutter limits, and narrow delivery envelopes due to store separation problems, must be alleviated or eliminated to achieve the effectiveness desired of aircraft and munitions as a tactical system.

Hindsight clearly shows that independent development of armament and delivery aircraft, even with the application of vast national resources, produces aeronautical systems lacking in effectiveness, flexibility, safety and reliability. The goal of armament design engineers has been to provide safe, reliable and effective weapons commensurate with the performance capabilities of *inventory* aircraft. As a result, the interface between weapons and the aircraft has been fixed without due consideration to the total system. In such circumstances, the munition designer is forced to develop items compatible with existing suspension and release gear located at designated positions on the aircraft. These constraints on the weapon designer tend to inhibit conception of improved ordnance systems. Similarly, the aircraft designer has been provided with a list of stockpiled weapons to be mated with an advanced aircraft design. Consequently, many aircraft/munition interface problems remain unresolved.

Personnel responsible for aircraft and ordnance system design should be emphatically reminded that effective armament is essential to a successful mission and that the primary purpose of an attack aircraft is to serve as a weapons delivery platform. The total system development objective should be to design, develop and qualify a complete aircraft/weapon system capable of carrying and accurately delivering ordnance appropriate for its specific mission.

Delivery Accuracy

General John P. McConnell, former Air Force Chief of Staff, stated that aircraft weapon systems capable of providing improved delivery accuracy would provide a significant breakthrough by narrowing the wide gap between present-day conventional and nuclear armaments. Although aircraft performance characteristics have steadily increased, the errors associated with the delivery of weapons have also increased. A degradation in delivery accuracy is to be expected under high-speed conditions due to difficulties in target acquisition and an increase in range of weapons from the release point to the target.

Sophisticated avionic subsystems have compensated for some of these errors; however, a major source of the inaccuracy of conventional free-fall weapons results from unpredict-

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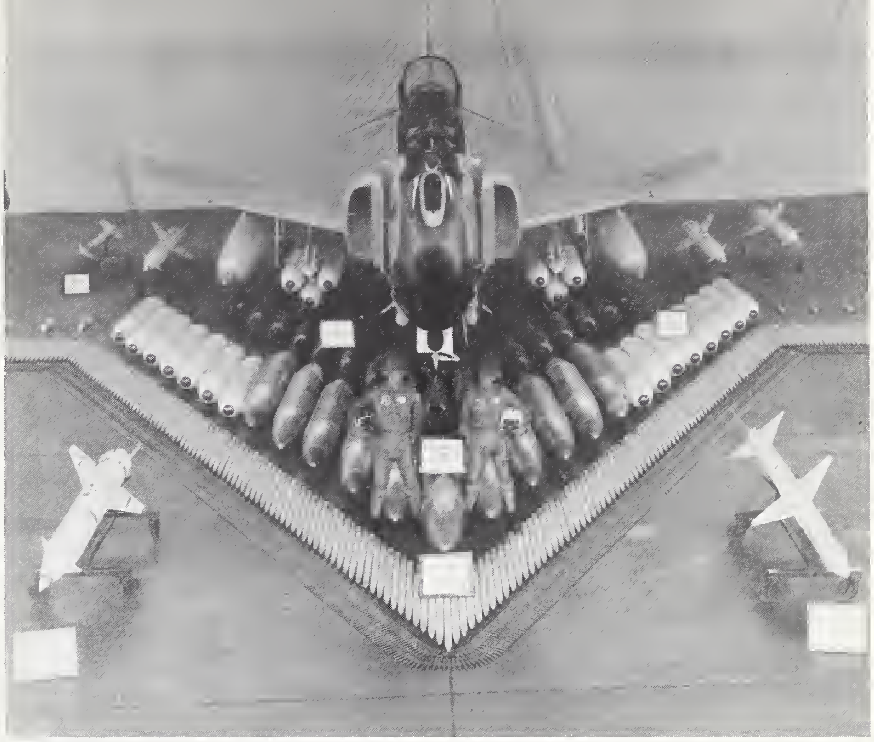
able perturbations experienced by the weapon during the release phase. These weapon perturbations result from exposure to a complex flow field which varies with each load configuration and every release condition. Considerable effort appears warranted to conceive improved suspension and release techniques which would enhance flexibility, safety and accuracy over existing methods.

Current Problems

The problems facing our tactical air forces today are not to be attributed totally to a technical lapse on the part of designers. The well known shift of national strategy which followed the Korean conflict diverted economic resources to support a nuclear policy of massive retaliation. Only token effort was directed at developing an effective conventional weapons capability (or correcting deficiencies) for coping with a limited war situation. The outbreak of hostilities in Southeast Asia necessitated retrofit and modernization of antiquated hardware, much of which had been in the stockpile since World War II. New ordnance items were hastily developed and pressed into service to be compatible with aircraft which were either designed to carry nuclear munitions or were designed initially as fighters. The outgrowth has been the continued expenditure of resources in finding solutions to urgent operational problems.

Although many compatibility problems have been resolved, our arsenal still consists of a variety of weapons and aircraft, many of which are ill-suited to each other and inadequate for their intended purpose. An example is the variety of munitions which are flown on F–4 and F–105 fighter aircraft. Fortunately, resourceful ordnance personnel have provided multiple carriage bomb racks. They have resolved some of the compatibility problems to enable use of these aircraft in an attack role. It should be noted that a similar trend of converting fighters to fighter-bombers occurred during World War II and was re-established during the Korean conflict. The need for designing an aircraft/weapon system tailored for specific roles should by now be evident.

In spite of the problem areas, airpower continues to play a major role in support of successful military operations; however, the desired levels of effectiveness have rarely been achieved.



The dual-purpose F–4 aircraft, surrounded by the variety of armament it carries in tactical operations.

Predicted Capability

Some of the reasons for current deficiencies in weapon systems have been delineated so that similar pitfalls can be avoided in the future. The lessons learned should provide guidelines for new development ideas which will eliminate many of the current production, logistic and operational problems. A science and engineering manpower pool has been established in the aircraft and armament fields, and wide recognition of the importance of an adequate ordnance program is now found in Government and industry. With this as a basis for prediction, I am confident that the breakthrough in operational capabilities to which General McConnell referred can be obtained. The technology is available and, with proper planning, management and resources, dramatic improvements can be obtained. The development program visualized will fully integrate aircraft, weapon and ancillary component designs into a total system, capable of providing the effectiveness needed in future tactical air operations.

Particular attention should be afforded to resolving logistic problems so that ready-to-use weapons are fully qualified in a factory to field operation. The design philosophies currently prevalent in the aircraft and ordnance fields should be aligned toward common goals. These goals will encompass the integration of munitions, release mechanisms, flight control systems and cockpit presentations into a system requiring the concurrent and coordinated design effort of cognizant personnel within the defense industry.

Future Efforts

To better assess the magnitude of the tasks before us, the Air Force Armament Laboratory of the Air Force Systems Command, located at Eglin AFB, Fla., has recently completed a cursory study of the problem areas, and has advocated implementation of an extensive effort involving designers, avionics experts, armament engineers and operational experts to further study and define a program for an Integrated Aircraft Armament System (INTAAS).

INTAAS is a development concept which proposes to fully integrate the design of aircraft, armament, and ancillary components into a *total* system, thereby affording maximum

effectiveness for future tactical operations. It is intended to resolve many of the logistic and tactical problems presently associated with combat operations. The INTAAS concept includes:

- Development of a new family of munitions.
- Modification of aircraft design philosophy.
- Integration of munition containers, release mechanisms, flight control systems, and cockpit presentations into a unified system.

To effect the improvements desired, all parts of the weapon system must be examined, including ordnance effectiveness, carriage and release methods, delivery envelopes, aircraft performance, crew capabilities, mission support activities, and total system effectiveness. INTAAS development will require close coordination with several Air Force laboratories, centers, system program offices, as well as appropriate elements of the Army, Navy and the National Aeronautics and Space Administration.

Design personnel from diversified technical disciplines will be used to achieve the desired total system. Designers will be required to extend their imagination in the design of munition containers and suspension systems compatible with attack aircraft. Wind tunnel tests will be conducted to further establish the feasibility of various methods of suspension and release of INTAAS stores from modified aircraft designs. Pre-fuzed munitions in the aerodynamically faired pods or containers will not require pre-flight assembly, checkout, or adjustment when employed in basic operational modes. Fuzing will incorporate automatic safing and arming systems, which are tied in with the aircraft computer, to provide a communication link between the pod and the aircraft.

Further study of the INTAAS concept will undoubtedly result in trade-offs, modifications, and the addition of alternate or additional objectives. The following represent some of the specific objectives of INTAAS now under consideration:

- Improved performance of loaded aircraft.
- Greater delivery mode flexibility.
- Aircraft/munition system compatibility.
- Cockpit selection fuzing and arming options.
- Improved fire control systems with simplified cockpit displays.
- Simplified munitions handling and loading.
- Logistic improvements.
- Greater environmental and radiation hazard resistance.
- Improved maintainability.
- Increased reliability.
- Improved safety.
- Automated pre-flight checkout.
- Reduced aircraft vulnerability.
- Reduced radar cross-section.

The benefits to be gained by the development and implementations of the INTAAS concept are intended to be applicable throughout the entire stockpile to target sequence. Prepackaging of ready fuzed munitions would resolve many logistic problems and reduce associated manpower requirements. Handling and loading procedures are to be simplified, thereby reducing aircraft turn-around time and improving reliability of the ordnance system. The aircraft with its INTAAS-oriented payload will present a low-drag configuration for greater speed, maneuverability, and increased range to target. Improvements in delivery accuracy, and in the terminal effectiveness of weapons, would result in a fewer number of sorties flown. Although the list of objectives is long, improvements in one area, generally, represent mutual gains for other aspects of the total system as previously described. Thus, it is conceivable to incorporate most of the objectives in a system which is not overly complex.

In conclusion, it is clear that global Communist strategy will not permit the neglect of nonnuclear munitions development as has occurred in the past. Acknowledgment of present inefficiencies serves to illuminate the need for vast improvements to deal with Communist-inspired wars of national liberation in the future. The manpower and technological base capable of putting the "weapon" in the "weapon system" is available to define and design an effective system in a unified manner. The increase in operational capabilities afforded by *total* aircraft weapon system design, such as proposed for INTAAS, will provide the nation with a fully responsive instrument to deal promptly and *decisively* with any future combat requirements.

Without armament, there is no Air Force.
—Lord Hugh M. Trenchard

Lockheed Awarded Navy S-3A Contract

The Department of the Navy has announced the awarding of the contract for the development of the S–3A antisubmarine warfare aircraft, formerly known as the VSX, to Lockheed Aircraft Corp., Burbank, Calif.

The $461 million contract represents the ceiling figure to be funded over the next five years, leading to the production of six research and development aircraft. The contract gives the Navy the option of procuring 193 production models of the S–3A, dependent upon a successful development phase of the program.

Full funding of the first year's installment for the airframe—approximately $120 million—is contingent on Congressional action on FY 1970 funding requests.

An estimated 50 percent of the S–3A's cost will be for avionics.

Although covering only the research and development phase, the initial contract specifies ceiling prices for each year's production. Subsequent production contracts will be priced separately, and production options will be exercised only after satisfactory attainment of performance "milestones."

The S–3A is to replace the S–2 Tracker, which has been in service for more than 15 years. The new aircraft will be powered by two General Electric TF–34 turbofan engines, and will be capable of speeds greater than 400 knots. These turbofan engines, designed for low fuel consumption, will give the S–3A a range of more than 2,000 nautical miles. First flight of the aircraft is expected in early 1972, with fleet introduction in 1973.

Capt. F. H. Baughman of the Naval Air Systems Command has been named project manager of the S–3A program.

ILC Relocated

The Army Institute of Land Combat (ILC) has been relocated from Fort Belvoir, Va., to the Hoffman Building, Alexandria, Va. ILC shares its new headquarters with two other Army advance concepts organizations, the Advanced Material Concepts Agency (AMCA), and the Intelligence Threat Analysis Group (ITAG).

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Maj. Gen. Francis W. Nye, USAF, has been assigned as Dep. Dir., Defense Atomic Support Agency (DASA), and Commander, Field Command, DASA, Sandia Base, N.M.

Maj. Gen. Royal B. Allison, USAF, is the new Asst. to the Chairman, Strategic Arms Negotiations, Office of the Joint Chiefs of Staff, Washington, D.C.

The Defense Supply Agency has announced the following assignments at its headquarters, Alexandria, Va.: **Rear Adm. Frederick W. Corle**, SC, USN, has been named Exec. Dir., Technical and Logistic Services. **Maj. Gen. Daniel E. Riley**, USAF, succeeds **Rear Adm. Ira F. Haddock**, SC, USN, as Asst. Dir., Plans, Programs and Systems. **Brig. Gen. (designee) Frank C. Lang**, USMC, assigned as Dep. Asst. Dir., Plans, Programs and Systems. **Capt. Jerome J. Scheela**, SC, USN, to be Dep. Comptroller.

Capt. Gilbert S. Young, SC, USN, succeeds **Col. Loren P. Murray**, USAF, as Commander, Defense Contract Administration Region, Atlanta, Ga.

DEPARTMENT OF THE ARMY

Dr. J. Ronald Fox has been sworn in as Asst. Secretary of the Army (Installations and Logistics).

Lt. Gen. George I. Forsythe has become Commander of the Army Combat Developments Command, Fort Belvoir, Va., succeeding **Lt. Gen. Harry W. O. Kinnard**. Lt. Gen. Kinnard retired.

Lt. Gen. Henry A. Miley Jr. is the new Dep. Commanding General, Army Materiel Command.

Maj. Gen. Paul A. Feyereisen is now Dir., Materiel Requirements, Army Materiel Command.

Maj. Gen. Edward L. Rowny recently assumed the post of Dep. Chief, Office of the Chief of Research and Development, Dept. of the Army.

Brig. Gen. Darrie H. Richards has assumed command of the Western Area, Military Traffic Management and Terminal Service, Oakland, Calif.

Col. Warren D. Hodges is the new Chief of Staff, Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

Col. Donald L. Jersey has relieved **Col. Clifton Duty** as Dep. Commander for Acquisition, Army Aviation Systems Command, St. Louis, Mo. Col. Clifton retired.

Col. Kenneth W. Koch is the new Senior Combat Developments Command Liaison Officer to U.S. Army, Vietnam.

The Army Corps of Engineers has a new Chief of the Technical Liaison Office, **Lt. Col. Richard L. Hunt**, replacing **Col. William K. Jordan**, who retired.

DEPARTMENT OF THE NAVY

Rear Adm. Clarence E. Bell Jr. has been appointed new Dir., Navy Program Planning, Office of the Chief of Naval Operations.

Rear Adm. Walter M. Enger, CEC, was named Commander, Naval Engineering Facilities Command, Washington, D.C., and Chief of Civil Engineers of the Navy.

Rear Adm. John W. Dolan Jr. has been assigned duty as Dep. Commander for Shipyard Management, and Program Dir. for Shipyard Modernization, Naval Ship Systems Command, Washington, D.C.

Brig Gen. Foster C. LaHue, USMC, has reported to Hq., U.S. Marine Corps, as Dep. Asst. Chief of Staff (Plans).

Rear Adm. Daniel K. Weitzenfeld has become Asst. Commander for Material Acquisition, Naval Air Systems Command, Washington, D.C.

Brig. Gen. (designee) Edward S. Fris, USMC, is the new Inspector General of the Marine Corps.

Capt. George G. Ball has replaced **Capt. Ernest F. Schreiter** as Commander, Naval Ordnance Laboratory, White Oak, Md. Capt. Schreiter has retired.

DEPARTMENT OF THE AIR FORCE

Hq., USAF, has announced the following changes in staff assignments: **Maj. Gen. Russell E. Dougherty** is the new Asst. Dep. Chief of Staff, Plans and Operations. **Maj. Gen. Gerald F. Keeling**, former Asst. Dep. Chief of Staff, Systems and Logistics, has retired. **Brig. Gen. Leslie W. Bray Jr.** has succeeded **Maj. Gen. Thomas N. Wilson** as Dep. Dir. of Plans, Office of the Dep. Chief of Staff, Plans and Operations. **Brig. Gen. Carroll H. Bolender** has assumed duties as Dep. Dir. of Development, Office of the Dep. Chief of Staff, Research and Development. **Brig. Gen. (designee) James R. Allen** is now Dep. Dir. of Plans and Policy, Office of the Dep. Chief of Staff, Plans and Operations.

Brig. Gen. Harvey W. Eddy has taken command of the Office of Aerospace Research, Arlington, Va.

Brig. Gen. William G. King Jr. has succeeded **Maj. Gen. John L. Martin Jr.** as Dir. of Special Projects, Office of the Secretary of the Air Force, with duty station in Los Angeles, Calif. Maj. Gen. Martin has been named Asst. Dep. Chief of Staff for Systems, Hq. AFSC.

Other reassignments announced by AFSC include: **Maj. Gen. James T. Stewart** is the new Dep. Chief of Staff, Systems, Hq. AFSC; he replaces **Maj. Gen. John L. Zoekler**, who has retired. **Maj. Gen. Lee V. Gossick** has assumed the duties of Commander, Aeronautical Systems Div., Wright-Patterson AFB, Ohio; his new Vice Commander is **Maj. Gen. Edmund F. O'Conner**. **Brig. Gen. William S. Chairsell** is now Vice Commander, Armament Development and Test Center, Eglin AFB, Fla. **Brig. Gen. Warner E. Newby** has taken command of the Air Force Contract Management Div., Los Angeles, Calif. The new Vice Commander, Electronics Systems Div., L. G. Hanscom Field, Mass., is **Col. Paul H. Kenny**.

Editor's Note: Organization charts appearing in the Bulletin are edited to reflect those elements of the various DOD organizations which are of interest to industry representatives. Organizational elements not involved in the DOD-industry relationship have been eliminated because of space limitation.

The information on personnel and telephone numbers is as current as is possible to obtain at the time we go to press.

DEPARTMENT

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DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

DIRECTOR, Hon John S Foster Jr	3E1006	79111
DEP DIR, Gardiner L Tucker	3E1014	57178
DEP DIR (ADMIN, EVAL & MGT), V/A Vincent P DePoix, USN	3E1030	74176
DEP DIR (ELEC & INFO SYS), G L Tucker	3E110	57345
DEP DIR (RESEARCH & TECHNOLOGY), Donald M MacArthur	3E144	55036
DEP DIR (SE ASIA MATTERS), Leonard Sullivan Jr	3E1082	74172
DEP DIR (STRAT & SP SYS) Roland F Herbst	3E130	79386
DEP DIR (TACT WAR PROG), C A Fowler	3E1040	59713
ADVANCED RESEARCH PROJECTS AGENCY: DIR, Eberhardt Rechtin	3E160	78255
WEAPONS SYSTEMS EVALUATION GROUP (400 Army-Navy Drive, Arlington, Va.) DIR, V/A K S Masterson USN		76335
DEFENSE SCIENCE BOARD: CHMN, Robert L Sproull	3D1040	54157

ASSISTANT SECRETARY OF DEFENS[E] ADMINISTRATION

ASST SEC, Hon Robert F Froehlke	3E822
ACT PRIN DEP ASST SEC, David O. Cooke	3E822
DIR FOR SECURITY POLICY, Joseph J Liebling	3C275
DIR FOR INSPECTION SERVICES, Lt Gen Hugh M Exton USA	3E988
ACT DIR (ORG & MGT PLNG) Col Robert E Morrison USAF	3E827
NATIONAL COMMUNICATIONS SYSTEM STAFF, Col Wm G McDonald USAF	3C920

JOINT CHIEFS OF STAFF

CHAIRMAN, JOINT CHIEFS OF STAFF, Gen Earle G Wheeler USA	2E873	79121
THE ASST TO THE CHAIRMAN, L/G John B McPherson USAF	2E873	79121
EXEC OFF, Col C A Jackson USA	2E873	79121

CHIEF OF STAFF, ARMY, Gen Wm C Westmoreland	3E668	52077
EXECUTIVE, Ltc Wm Steele	3E668	52110

CHIEF OF STAFF, AIR FORCE, Gen John D Ryan	4E929	79225
EXECUTIVE, Col Otis C Moore	4E929	79225

CHIEF OF NAVAL OPERATIONS, Adm T H Moorer	4E660	56007
EXECUTIVE ASSISTANT, Capt J J LeBourgeois	4E672	55664

COMMANDANT OF THE MARINE CORPS, Gen L F Chapman Jr	NA2004	42500
MILITARY SECRETARY, Col F E Haynes Jr	NA2004	42501

ASSISTANT SECRETARY OF DEFENSE MANPOWER AND RESERVE AFFAIRS

ASST SEC, Hon Roger T Kelley	3E966	52334
DEP ASST SEC, V/A Wm P Mack USN	3E966	50991
DEP ASST SEC (CIVIL RIGHTS & INDUSTRIAL RELATIONS), L Howard Bennett (Actg)	3B938	76381
DEP ASST SEC (CIVILIAN PERSONNEL POLICY), Carl W Clewlow	3D976	55348
DEP ASST SEC (EDUCATION), N Brodsky (Actg)	3D258	70617
DEP ASST SEC (HEALTH & MEDICAL) Louis M Rousselot, MD	3E286	72111
DEP ASST SEC (MILITARY PERSONNEL POLICY), B/G Leo E Benade USA	3C961	74166
DEP ASST SEC (RESERVE AFFAIRS)	3C956	74222
DEP ASST SEC (MANPOWER RESEARCH & UTILIZATION), Paul Wolistadt	3D257	53114

ASSISTANT SECRETARY OF DEFENSE PUBLIC AFFAIRS

ASST SEC, Hon Daniel Z Henkin	2E800
PRIN ASST SEC, Richard G Capen Jr	2E800
DEP ASST SEC (OPERATIONS), Jerry W Friedheim	2E800
DIR OF DEFENSE INFORMATION DIR, Col R R Bankson USA	2E761
DIR FOR COMMUNITY RELATIONS DIR, Col G F Hamel USA	2E773
DIR FOR PLANS & PROGRAMS DIR, Col John T Merrill USA	1E771
DIR FOR SECURITY REVIEW DIR, Charles W Hinkle	1B683

DEFENSE CONTRACT AUDIT AGENCY

Bldg. 4, Cameron Station, Alexandria, Va.

DIRECTOR, William B Petty	4C346	47281
DEPUTY DIRECTOR, B B Lynn	4C346	46785
DEP FOR AUDIT MGT, F Neuman	4A165	47323
DEP FOR RES MGT, H W Kettles	4A350	47308
DEP FOR REV & EVAL, J L Kiraly	4A415	47351

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DEP DIR (CAS), R/A Joseph L How

SPEC ASST FOR PUB AFF, Eugene

ASST DIR, PLANS, PROGRAMS & M/G Daniel E Riley USAF

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EXEC DIRECTORATE, PROCUREME PRODUCTION, B/G James R Pu

EXEC DIRECTORATE, TECHNICAL SERVICES,

EXEC DIR CONTRACT ADMINISTR Col Henry M Fletcher USAF

EXEC DIR QUALITY ASSURANCE, Col J C Coyne USA

EXEC DIR PRODUCTION John S Groupe

DEFENSE DOCUMENTATION CTR (F TECHNICAL INFO), DIR, Dr R B

OFFICE, CUSTOMER RELATIONS,

DIRECTOR, JOINT STAFF

DIRECTOR, V/A N C Johnson USN	2E936	74084

JOINT STAFF

J-1 - PERSONNEL DIRECTORATE

DIRECTOR, R/A P W Jackson USN	1B738	73062

J-3 - OPERATIONS DIRECTORATE

DIRECTOR, L/G J W Vogt Jr USAF	2D878	73702

J-4 - LOGISTICS DIRECTORATE

DIRECTOR, V/A L Ensey USN	2E828	52732

J-5 - PLANS & POLICY DIRECTORATE

DIRECTOR, L/G F T Unger USA	2E1000	55618

J-6 - COMMUNICATIONS-ELECTRONICS DIRECTORATE

DIRECTOR, M/G A T Shtogren USAF	1D776	71998

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SPECIAL ASST, B/G D D Blackburn USA	1E956	59852

JOINT COMMAND AND CONTROL REQUIREMENTS GROUP

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JOINT WAR GAMES AGENCY

CHIEF, B/G W H Birdsong USA	1D957	57769

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SPECIAL ASSISTANT, R/A John H Maurer USN	2E844	50953

SPECIAL ASSISTANT FOR ARMS CONTROL

SPECIAL ASSISTANT, M/G B F Evans USA	1E969	71227

JOINT SECRETARIAT

SECRETARY, JCS, B/G R C Crompton	2E935	72700

DIRECTORATE OF ADMINISTRATIVE SERVICES

DIRECTOR, Col G O Romstedt USA	2E949	74987

SPECIAL ASSISTANT FOR MILITARY ASSISTANCE AFFAIRS

SPECIAL ASSISTANT, M/G G Ruhlen USA	1E843	75225

ARY OF DEFENSE

LAIRD	3E880	55261

:RETARY OF DEFENSE

CKARD	3E921	56352

ASSISTANT SECRETARY OF DEFENSE COMPTROLLER

ASST SEC, Hon Robert C Moot	3E854	53237
PRIN DEP ASST SEC, Don R Brazier	3E843	59252
DEP ASST SEC(MANAGEMENT SYSTEMS DEVELOPMENT), George W Bergquist	3E838	53424
DEP ASST SEC (INFORMATION), George W Bergquist (Actg)	3A882	53147
DEP COMP (INTERNAL AUDIT), Joseph P Welsch	DB407	79108

ASSISTANT SECRETARY OF DEFENSE INSTALLATIONS & LOGISTICS

ASST SEC, Hon Barry J Shillito	3E808	55254
PRIN DEP ASST SEC, Glenn V Gibson	3E808	71163
DEP ASST SEC(SUPPLY & SERVICES), Paul H Riley	3E808	71368
DEP ASST SEC (MATERIEL), M/G A T Stanwix-Hay	3E784	57145
DEP ASST SEC (PROCUREMENT), John M Malloy	3E760	78177
DEP ASST SEC(INSTALLATIONS & HOUSING) Edward J Sheridan	3E760	79155
DEP ASST SEC (LOG MGT SYS & PROG) George E Fouch	Lynn Bg	44857

ASSISTANT SECRETARY OF OEFENSE INTERNATIONAL SECURITY AFFAIRS

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DEP ASST SEC (POLICY PLANNING & ARMS CONTROL), Y L Wu	4E820	73331
DEP ASST SEC (AFRICA & WESTERN HEMISPHERE), William E Lang	4E830	75334
DEP ASST SEC (EAST ASIA & PACIFIC AFFAIRS), Dennis J Doolin	4E830	72307
DEP ASST SEC (MILITARY ASSISTANCE & SALES), L/G Robert H Warren USAF	4E837	53291
DEP ASST SEC (NEAR EAST & SOUTH ASIAN AFFAIRS), Robert J Pranger	4E840	75146
DEP ASST SEC (EUROPEAN & NATO AFFAIRS),	4E840	78101

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DEP ASST SEC (STRATEGIC PROGRAMS), Charles H Bernstein	2E314	50721
DEP ASST SEC (REGIONAL PROGRAMS) Phillip A Odeen (Actg)	2E270	70448
DEP ASST SEC (RESOURCE ANALYSIS) Donald B Rice Jr	2E334	50528

GENERAL COUNCIL OF THE DEPARTMENT OF OEFENSE

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DEPUTY GENERAL COUNSEL, Leonard Niederlehner	3E980	77248

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ASSISTANT TO THE SECRETARY LEGISLATIVE AFFAIRS

ASST TO THE SEC, Jack L Stempler	3E944	76211
DEP ASST TO THE SEC, B/G J F Lawrence Jr USMC	3E944	75381

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	3A150	46111
	3A150	46113
	8A310	47091
	3A210	46135
	3A426	46271
	4D276	461D1
	4D231	46401
	4D530	46771
	8A43D	47704
	8D468	47754
	8D425	47647
	5D120	46833
:	5A114	47067

DEPARTMENT OF THE ARMY

SECRETARY OF THE ARMY, Hon Stanley R Resor		3E718	53211
UNDER SECRETARY, Hon Thaddeus R Beal		2E722	54311
ASA (I&L), Hon J Ronald Fox		3E606	52254
ASA (R&D), Charles L Poor (Actg)		3E390	56153
ASA (FM), Hon Eugene M Becker		2E678	54291
ASA (M&RA), Hon William K Brehm		2E594	79253
CH, PUB INFO, M/G Wendell J Coats		2E636	55135
CHIEF OF STAFF, Gen Wm C Westmoreland		3E668	52077
VCS, Gen Bruce Palmer Jr		3E668	54371
DCS/OPS, L/G Richard G Stillwell		3E648	52904
DCS/PER, L/G Walter T Kerwin		2E736	56003
DCS/LOG, L/G Joseph M Heiser Jr		3E560	541D2
COMPTROLLER, L/G Frank J Sackton		3A72D	52510
CHIEF OF R&D, L/G Austin W Betts		3E412	78186
ACSFOR, L/G Arthur S Collins Jr		3E468	55775
CofENGRS,L/G Frederick J Clarke	Tempo 7	1230	52052
IG, M/G Wm A Enemark	Y & D Ann	1B3	52182

DEPARTMENT OF THE NAVY

SECRETARY OF THE NAVY, Hon John H Chafee		4E686	53131
UNDER SECRETARY, Hon John W Warner		4E728	53141
ASN (I&L), Hon Frank Sanders	MN	2046	63213
ASN (FM), Hon Charles A Bowsher		4E748	72325
ASN (M&RA), Hon James D Hittle		4E788	73913
ASN (R&D), Hon Robert A Frosch		4E736	56315
CH INFO, R/A L R Geis		2E338	77391
CH NAVAL RESEARCH, R/A T B Owen	MN	0449	64911
COMPTROLLER, Hon Charles A Bowsher		4E748	72325
CNO, Adm Thomas H Moorer		4E660	56007
VCNO, Adm B A Clarey		4E644	78347
DCNO (AIR), V/A Thomas F Connolly		4E394	52374
DCNO (DEV), R/A E A Ruckner		5C710	75533
DCNO (FO&R), V/A John B Colwell		4E552	77469
DCNO (LOG), V/A R L Shifley		4E606	52154
DCNO (M&NR), V/A C K Duncan		4E474	411D1
DCNO (P&P), V/A F J Blouin		4E588	537D7
NAVINSGEN, V/A A R Gralla	AA	1046	43126
OCEANOGRAPHER OF THE NAVY, R/A O D Waters JR		Mad	56002
CHIEF, NAVAL MATERIAL, Adm I J Gallantin	MN	2010	68500
COMDT OF MARINE CORPS, Gen L F Chapman Jr	AA	2004	42500
ASST COMDT, Gen Lewis W Walt	AA	2001	41201
DCS (P&P), L/G Ralph K Rottet	AA	2D20	42503
DCS (MANPOWER), L/G Herman Nickerson Jr	AA	2024	48003
DCS (RD&S), M/G Louis Metzger	AA	2307	41172
DCS (AIR), M/G Keith B McCutcheon	AA	2313	41023
DIR OF INFO, B/G Frank E Garretson	AA	3202	42958
INSPECTOR GENERAL, M/G Louis B Robertshaw	Don Bg Rm	904	41533

DEPARTMENT OF THE AIR FORCE

SECRETARY OF THE AIR FORCE, Hon Robert C Seamans Jr	4E871	77376
UNDER SECRETARY, Hon John L McLucas	4E871	71361
ASAF (R&D), Hon Alexander Flax	4E973	76361
ASAF (I&L), Hon Philip N Whittaker	4E856	78147
ASAF (FM), Hon Spencer J Schedler	4E978	72302
ASAF (M&RA), Hon Curtis W Tarr	4E1000	56383
THE GENERAL COUNSEL, John M Steadman	4E965	70941
DIR, INFO, B/G Henry L Hogan III	4D922	76061
DIR, SPACE SYSTEMS, B/G Russell A Berg	4C1000	78675
VICE DIR, MOL PROG OFF, M/G James T Stewart	5D227	50961
CHIEF OF STAFF, AIR FORCE, Gen John D Ryan	4E929	79225
VICE CHIEF OF STAFF, Gen John C Meyer	4E936	57911
DCS/R&D, L/G Joseph R Holzapple	4E334	77151
DCS/PER, L/G Austin J Russell	4E194	71409
DCS/SYS & LOG, L/G Harry E Goldsworthy	4E262	53153
DCS/P&O, L/G Lucius D Clay Jr	4E1D20	79991
COMPTROLLER, L/G Theodore R Milton	4E126	74774
DCS/P&R, L/G George S Boylan, Jr	4E1006	55226
INS GEN, L/G Joseph H Moore	4E1076	76733
USAF SCIENTIFIC ADV BD, H G Stever	5D1D14	74811

* Washington personnel only

DEFENSE ATOMIC SUPPORT AGENCY

Thomas Bldg., 2020-14th St., N. Arlington, Va.

DIRECTOR, V/A L M Mustin USN	780	45697
EXECUTIVE OFFICER, Col P C Donohoe USA	780	45692

DEFENSE COMMUNICATIONS AGENCY

(Bldg. 12, Naval Service Center, 8th and South Court House Road, Arlington, Va.)

DIRECTOR, L/G Richard P Klocko USAF	4225	43155
VICE DIRECTOR, R/A Robert H Weeks USN	413D	45223
EXECUTIVE OFFICER, L/C J J Fiederer USAF	4136	43486

OEFENSE INTELLIGENCE AGENCY

DIRECTOR, L/G J F Carroll USAF	3E258	57353
DEPUTY DIRECTOR, V/A Vernon L Lowrance	3E258	75128
EXEC, Col H G Creyts USAF	3E258	78844

MEETINGS AND SYMPOSIA

OCTOBER

Chauvenet Memorial Symposium, Oct. 17–18, at the U.S. Naval Academy, Annapolis, Md. Sponsors: Office of Naval Research, The U.S. Naval Academy and the Mathematical Association of America. Contact: Dr. Leila D. Bram, Office of Naval Research, Code 432, Washington, D.C. 20360, phone (202) 696–4644; or Prof. James Abbott, U.S. Naval Academy, Annapolis, Md. 21402. Phone (301) 268–7711 Ext. 552.

Fifteenth Design of Experiments in Army Research, Development and Testing Conference, Oct. 22–24, Redstone Arsenal, Ala. Sponsors: U.S. Army Research Office-Durham, and the Army Mathematics Steering Committee of the Office of the Army Chief of Research and Development. Contact: Dr. Francis G. Dressel, Mathematics Division, U.S. Army Research Office—Durham, Box CM, Duke Station, Durham, S.C. 27706. Phone (919) 286–2285, Ext. 75.

Biochemical and Pharmacological Aspects of Climatic Stress Symposium, Oct. 27–29, at the U.S. Army Research Institute of Environmental Medicine, Natick, Mass. Sponsor: Department of the Army. Contact: Dr. A. H. Hegnauer, Research Program Officer, U.S. Army Research Institute of Environmental Medicine, Natick, Mass. 01760. Phone (617) 955–2814.

Mathematical and Computer Aids to Design Symposium, Oct. 27–31, at the Disneyland Hotel and Convention Center, Anaheim, Calif. Sponsors: Office of Naval Research, Society for Industrial and Applied Mathematics, Association for Computing Machinery, and the Institute for Electrical and Electronics Engineers. Contact: Dr. Leila D. Bram, Office of Naval Research, Code 432, Washington, D.C. 20360, phone (202) 696–4644; or Dr. W. J. Jameson Jr., Collins Radio Co., Cedar Rapids, Iowa. 52406. Phone (215) LOcust 4–2929.

Navy Contract Aerospace Services Symposium, Oct. 29, at the Hotel America, Washington, D.C. Sponsor: National AeroSpace Services Association. Contact: Harry S. Baer, Executive Director, 1725 DeSales St. NW, Washington, D.C. 20036. Phone (202) 393–0211.

NOVEMBER

Second Annual **Armed Forces Audio-Visual Communications** Conference, Nov. 3–7, at the Sheraton-Park Hotel, Washington, D.C. Sponsor: Department of the Army. Contact: HQUSAF (AFXO-TV), 2–AFAVCC Registration Committee, Washington, D.C. 22030. Phone (202) 693–2615.

Fifteenth Annual **Army Human Factors Research and Development** Conference, Nov. 4–6, at Fort Ord, Calif. Sponsor: Behavorial Sciences Division of the Office of the Chief of Army Research and Development. Contact: Lynn E. Baker, U.S. Army Chief Psychologist, Behavorial Sciences Division, Office of the Chief of Research and Development, Department of the Army, Washington, D.C. 20310. Phone (202) OXford 4–3693.

VTOL Environmental Requirements Symposium, Nov. 17–18, at Arlington, Tex. Co-sponsors: Aeronautical Systems Division (AFSC), American Helicopter Society and the University of Texas. Contact: Mr. Kuehne, Aeronautical Systems Division (ASZT), Wright-Patterson AFB, Ohio 45433. Phone (513) 255–3224.

Magnetism and Magnetic Materials, Nov. 17–20, at the Benjamin Franklin Hotel, Philadelphia, Pa. Sponsors: Office of Naval Research, the Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers, the American Society for Testing and Materials, the Institute of Electrical and Electronics Engineers, and the American Institute of Physics. Contact: Dr. Hugh C. Wolfe, American Institute of Physics, 335 E. 45th St., New York, N. Y. 10017. Phone (212) 685–1940.

Fourth Naval **Training Device Center and Industry Cost Effective Training Devices** Conference, Nov. 18–20, at the Naval Training Device Center, Orlando, Fla. Sponsor: Naval Training Device Center. Contact: D. Robert Copeland, Conference Coordinator, Code 421, Naval Training Device Center, Orlando, Fla. 32813. Phone (305) 841-5611, Ext. 664.

Titanium Technical Conference, Nov. 18–20, at Dayton, Ohio. Co-sponsors: Air Force Materials Laboratory and the University of Dayton Research Institute. Contact: Dr. Gegel, Air Force Materials Laboratory (MAMS), Wright-Patterson AFB, Ohio 45433. Phone (513) 256–5561.

DECEMBER

Eighteenth **International Wire and Cable** Symposium, Dec. 3–5, at the Shelburne Hotel, Atlantic City, N.J. Sponsor: U.S. Army Electronics Command. Contact: Milton Tenzer, Symposium Chairman, Electronics Parts and Materials Division, Electronic Component Laboratory, U.S. Army Electronics Command, Fort Monmouth, N.J. 07703. Phone (201) 535–1834.

Third **Circuits and Systems** Conference, Dec. 10–12, at Pacific Grove, Calif. Sponsors: Naval Postgraduate School, the University of Santa Clara, Stanford University, and the Circuit Theory and Automatic Control Group of the Institute of Electrical and Electronic Engineers. Contact: Sydney R. Parker, Naval Postgraduate School, Monterey, Calif. 93940.

Master Planning the Aviation Environment Symposium, Dec. 17–19, at Del Webb Townhouse, Phoenix, Ariz. Sponsors: Arizona Department of Aeronautics, Arizona State University, and Luke AFB, Ariz. Contact: James Vercellino, Director, Arizona Department of Aeronautics, 3000 Sky Harbor Blvd., Phoenix, Ariz. 85034. Phone (602) 275–9169.

Forecasting Future Military Missions and Their Technological Demands

Dr. Donald M. MacArthur

The day-to-day management of Defense Department research and development, which is the current work of many of us, is in a sense nothing but forecasts. We must try to forecast potential threats. We try to forecast the potential of various fields and scientists that compete for our resources. We try to forecast the costs and payoffs of various development plans. As a regular part of management, we compare our past forecasts and plans with our current performance.

But the single most important job of defense research and development is to think—and think hard—about the options and the capabilities which the President and the Secretary of Defense may need in the future. We try to do this. Usually when we finish, we have a long list of projects designed to guard against a range of contingencies and to prepare for a range of sometimes relatively improbable needs. At this point, of course, the list is cut based upon the national priorities and the budgetary constraints. The crucial point, however, is that research and development is in the *option-creating* business, leading to ways of fulfilling national commitments with *alternative* methods, building *new* understanding of the interactions between policies, missions and technologies.

Overall, even though much of our business could be regarded as forecasts, we usually do not think of it that way. Too often there are unexpected problems, new solutions, unforeseen issues, unpredictable events. The Defense Department may be asked to carry out a mission on short notice which no one anticipated and this perhaps distinguishes defense research and development from the research and development supporting other national goals. In fact, the interaction of national policies, missions and technologies is clearly a "chicken-egg" phenomenon. New technology has forced decisions on new national policies and major missions—this happened with ICBMs. And a major policy decision can create a new mission and stimulate new technological requirements—this happened with our space program.

Once we understand that any mission-oriented research and development activity is inevitably in the forecasting business and in the business of influencing the future, we then see it is *both* the choice of long-term policies and missions, and the future technologies, which lie at the *heart of the forecasting problem.* Before going further, there are two obviously serious problems in developing this discussion. First, some of the detailed information central to an understanding of DOD's possible future missions is classified. Second, our crystal ball is neither panoramic enough nor blessed with high enough resolution to allow us to feel comfortable.

With these limitations in mind, this article will cover three areas:

- Interactions between choices of national goals and choices of military missions.
- Framework for thinking about the emphasis among possible future missions.
- Range of forecasting techniques and activities which DOD has employed and an indication of what they suggest about technological growth areas.

National Goals

To begin, we must understand our national objectives. Many experienced in national security affairs are today concerned with a reappraisal of past commitments in the light of our experience in Vietnam and the prospect of strategic arms talks with the Soviet Union. In Congress and on many university campuses, questions such as these are being raised: What is required to deter nuclear war? What kinds of arms control treaties are in the national interest, and how can they be enforced and how can we best handle our defense needs under the changed circumstances? What forms of defense alliances are needed, and how can they be made even more effective, in the future? What levels of standing forces do we need and how should they be deployed in association with our allies? Have the roles of air, land and sea power changed—and if so, what will we need in the future? Given that national security

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must be assigned a top priority in our Federal budget, taking account of our many pressing domestic needs, how much do we need to spend on defense?

Essentially, these questions and many other ones are continually under review. President Nixon has a series of studies underway now to reassess our national security policies.

The choices posed by the questions are so complex, and have such broad political and military significance, that the follow-up work on details of alternative military missions is comparatively straightforward. There are scores of branch-points in terms of differences in the relations among major powers and minor powers, in the likelihood of military action, and in the kinds of contingencies in which our forces might become involved. To discuss all of the possible outcomes and their implications would require much more space than is available here.

Thus, let us make a few assumptions, while recognizing the hazards involved in trying to state hypothetical national objectives.

Let us consider, first, that the guiding national policy will be to continue to work for a peaceful world in which nations settle their differences without resort to violence. It seems clear that to do this, the United States will continue to require a strategic nuclear deterrent sufficient in *both* size and technological quality to represent a clear *and* credible capability. This objective would be consistent, of course, with a range of possible arms control agreements. It also seems clear that general purpose forces will be needed to complement the strategic deterrent through a capability for deterring—and defending, if necessary—against lower levels of violence. The likely future size and basing of our general purpose forces are difficult to estimate because costs and the structure of alliances are key variables, on which judgments must be made at the highest level of our Government.

Military Mission Trends

With just this general framework of national objectives, we can begin to consider the trends in possible military missions.

Let us then consider the general categories of operational capabilities that appear to be what we have already decided we want in the foreseeable future. Assuming that strategic nuclear deterrence will remain the primary objective and that supporting military forces will be designed to deter lower-level conflict and to prevent escalation should conflict nevertheless occur, we will need continuing improvements in at least the following seven areas:

- First, and most important, continued emphasis on all of the equipment required for a sufficient and credible strategic nuclear deterrent in the face of what we can expect to be considerable uncertainties about growing Soviet and Chinese capabilities.
- Second, we will need to continue to improve our *all-weather, all-climate* fighting, capability, including our ability to hit targets *much more accurately* than we can today and at a cost commensurate with the *value of the target*. Another revolutionary concept first tested recently in Vietnam is the ability to provide around-the-clock, real-time battlefield surveillance.
- Third, high reliability and greater flexibility so that overall costs, and particularly logistic and maintenance requirements, can be minimized.
- Fourth, mobile and flexible deployment systems in small units, capable of rapid integration into larger units, sufficient to stop trouble before it breaks into major conflict.
- Fifth, much better understanding of the relationship among the military, political, economic, techncal, and psychological factors influencing successful deterrence along both the strategic and tactical dimensions of the use, or the threat of the use, of force.
- Sixth, strategic and tactical intelligence and surveillance data collection and processing systems.
- Seventh, strategic and tactical real-time, comprehensive command-control communications systems that allow detailed handling of dispersed units in crisis situations.

The third and fourth areas in this short but demanding list are especially critical if cnly because we too easily take them for granted and, thus, tend to dismiss them.

The costs for new defense systems must be reduced, wherever possible, consistent with our goals and commitments, even if we revise our goals and commitments. One way to do some of this is to seize all of the revolutionary opportunities emerging for very high reliability equipment. On the other hand, high reliability can also be achieved through extremely simple and durable designs, *e.g.*, in ground combat and communications equipment, which may be relatively inexpensive both to purchase and to maintain.

The tasks are to examine precisely what performance is required, and then to carry out an explicit analysis of the purchase costs and the long-range costs required to achieve the *necessary* reliable performance. Many new systems must, of course, have new, complex and costly components. In general, however, our trend in the future will be toward using long-term cost as an even more decisive criterion in selecting the level of sophistication of subsystems to incorporate into new systems. In some cases, this will mean a sacrifice in our performance goals to make sure that we achieve higher reliability objectives and reduce costs. Much broader test and evaluation programs will be required to ensure that we meet these reliability objectives.

The fifth area mentioned is a reminder that we must deepen and broaden our interdisciplinary studies of deterrence and defense, of the steps needed for successful arms control, and of the tactics required for successful deterrence of local low-level violence. This is complex, often controversial work drawing on the social sciences.

Future Technology

We have now looked briefly at the problem of national policy choices and military missions. Next, we should look at the trends in potentially useful technologies. In starting this task, we are again confronted with great complexity. How do you forecast the directions of growth of technology to satisy likely missions? Are there analytical tools available to help with such a job?

The answer is mixed. While there has been a considerable amount of successful work in forecasting and in the development of useful forecasting aids, it is fair to say that the field is still evolving. We can be more systematic and mathematical than the ancient prophets. Planning, forecasting, or prognosticating may seem formally easier now, but they still seem little better than the insight of those who practice this difficult profession.

It is basically *long-term* forecasting that is difficult—15 to 20 years or

more ahead. When we try to look 5 to 10 years ahead, the military needs are rather clear and the research and development paths are rather obvious even if the technology is not immediately available. In part, this is because of long development times. Farther into the future, few can make accurate predictions because scientific advances will create new options for *both* missions and the technologies in fulfilling old and new missions. Because of the long-term forecasting problem, we believe we must support a broad research program that "covers all bets." However, we do try to identify certain areas for emphasis which seem to possess "high-leverage" in solving national security problems.

In addition to our in-house work, we ask independent ad hoc task forces of the Defense Science Board to think hard in rather specific ways about the future needs of DOD. For example, the Director of Defense Research and Engineering asked, "Just what might his successor in 5 to 10 years wish had been started?" The task force, chaired by Dr. Simon Ramo, considered topics within the context of major developments in the 1980s that could be relevant to national security. The topics included the following, which are mixed between our problems and our technologies—what you might call our sicknesses and our cures:

• **Search, Identify and Destroy Missions.** Improvement in the battlefield surveillance and command and control will permit the rapid deployment of land forces, to seek out and destroy the enemy while he is on the move at night or in bad weather. The capability to use laser-guided weapons, under all environments, will be routine for airborne attack. Self-contained night and all-weather interdiction aircraft systems will detect, identify and destroy both fixed and fleeting targets, using a computerized system of sensors, communications and weapons. This will require improved navigational and terrain avoidance systems expected to be available by the early 1980s.

• **The Interdependence of Social, Technological, Economic, Military and Political Factors.** By the early 1980s, we can expect to have moved substantially beyond the present haphazard way in which these different considerations are related to each other. Military planners and defense managers of that period will be supported by extensive banks of information, based on observations of importance to DOD, made over a period of time, and computerized models. They will use these to distinguish between those interaction effects which are likely and those which are unlikely. Seated at a console, they could suggest alternative courses of action, run through the model, and receive back analysis of the probable major consequences. Similar methods could also be used to train personnel in these complicated and interrelated areas.

• **Accelerated Learning Techniques.** The formal classroom, standard curriculum, the fixed schedule of instruction will all be things of the past. DOD will employ a small number of massive central processing computers which will support 5 to 10,000 consoles for military students at distant locations. Defense Department personnel will be engaged in a continuous learning process in their field of primary interest of responsibility, *e.g.*, vocational, scientific, managerial. Supported by new forms of educational technology, they will learn according to their own speed and style. The hours of instruction will be those they choose. The place of instruction will be wherever they are located.

• **Lasers.** Foreseen new devices are tunable lasers which will give us the ability to do in the optical region what we can do today in the microwave region, *i.e.*, heterodyning, mixing, etc; and parametric conversion devices which would enable us to utilize the best techniques for a given problem. The key here is the expected availability of non-linear materials which can operate in optical regions.

• **Materials Development.** Incidentally, materials will continue to be the foundation of our success, and often the reason for our failures, in new systems of all kinds. The use of composite materials in aircraft should yield a weight savings of up to 50 percent which will double the range, or double the payload, or increase loiter time. New materials for lift engines will allow for increased payload of between 25 to 50 percent and a doubling of the thrust/weight ratio. We can look forward to manned transparent glass submersibles, capable of exploring and patrolling at depths sufficient to examine most of the oceans' bottoms. In space satellite applications, materials will be developed which will last for periods up to 15 years without degradation.

• **Identification of Friend or Foe (IFF).** Development of stand-off weapon systems demand that there be commensurate improvements in IFF equipment. It is hoped that technology can provide airborne IFF equipment that will permit firing weapons at maximum weapon range with minimum chance of revealing our aircraft position.

• **Computer-Based Information Processing and Pattern-Recognition Systems.** While present practical applications of these techniques are evident in character recognition devices we are familiar with (such as optical and magnetic character recognition for bank check accounting and retail store receipt compilation and accounting), there has been little day-to-day use in the military. In the next few years, however, we will be using these technologies in reconnaissance, surveillance, and data transmission.

• **Ocean Sciences and Engineering.** In the 1980s, our capabilities should permit us to go anywhere in the world's oceans at any time and at most depths. Nuclear reactors will be operating as power generators on the ocean floor. Airports will be constructed offshore and living on the ocean bottom can be commonplace for recreation and scientific investigations.

• **Weather Prediction and Modification.** Because weather depends on known scientific phenomena, and data can be secured and computer processed, worldwide weather conditions will be forecasted with greater accuracy for 30 days longer. Ultimately, everyday forecasting will be quite accurate through computer prognoses and worldwide satellite coverage of many more meteorological parameters. Accurate measurements from satellite-based sensors, particularly above 10,000 feet, will replace individual soundings now taken at multiple points on the surface, and will be coupled with inputs from atmospheric, water surface and underwater sensors. Weather modification techniques will be available for almost any type weather condition and limited in its extent only by legal, political and social demands.

• **Cryogenics.** Superconducting materials and devices are expected to be routinely used for computers and a

variety of electronic devices, enabling large savings in power consumption, smaller size and more efficient operation.

Obviously, this is an enormously broad and challenging array of topics. One of the most refreshing and useful characteristics of Dr. Ramo's work was that the recommendations were brief, and depended on qualitative reasoning based upon a realistic analysis of the current military and scientific situation. There is simply no substitute, when trying to forecast, for an understanding of the current situation. Someone once said that all the really good ideas he ever had came to him while he was milking a cow. Few of us milk cows these days. However, those who make military or technical forecasts relative to military systems should really know military or technical operations. If they do not, their forecasts can be no better than skimmed milk.

Forecasting: Which Direction?

In the past there has been continuing work on forecasting. Much of the long-range forecasting has been frankly labelled intuitive or judgmental. An expert—military or scientific—would simply make an analysis of what he believed would evolve in the future. Sometimes experts have gotten together to compare and criticize projections, and then develop a consensus viewpoint.

Other forecasting has been and is done in a more detailed way. Past trends can be plotted numerically and then compared or extrapolated. Analogies can be made and tested. Curves can be drawn for characteristics of fields large and small, and then adjusted to suggest either goals or expectations.

The Defense Department, since World War II, has contributed to many of these pioneering activities in forecasting and related enterprises. Reports have been commissioned by distinguished scientists and managers. Organizations have been established to concentrate on thinking about long-range issues. Retrospective analyses have been performed to document those lessons of the past that might be relevant to "managing" the future. As most of you know, each of the Military Departments today has groups of analysts trying to develop and analyze long-range requirements. Special experiments are being run to explore new ways of meshing requirements with allocations of research and development resources.

This article has covered the range of forecasting activities and a list of assorted topics to underscore one fundamental point. It is simply not possible today, given the broad range of defense missions and the almost bewildering pace of technological development, to predict with great confidence what *specific* shifts will occur in either missions or technological demands. Forecasting efforts are worth our investment only in the sense that they define the broad boundaries of our choices a bit better. They rarely provide detailed answers about what we need in the long term. The reason they do not—or perhaps more accurately, the reason they cannot—is simply that much of the future will be governed by our decisions rather than dominated by some impersonal factors that can be plotted and calculated. The country must decide on its commitments, and research and development must provide practical alternatives for fulfilling them. What is quite clear, then, is that the Defense Department must and will sustain a strong commitment to all of the research fields related to national security.

Our broad missions and our overall research and development needs are clear. Certainly the war in Vietnam has revealed many of our strengths and a number of our weaknesses. In the next 10 to 20 years, there will be no decrease—in fact, there will probably be an increase—in the strong dependence of national security upon advanced technology. We will be relearning and re-applying all of the lessons learned in past conflicts to ensure that our future forces will be even better prepared for whatever they are asked to do.

We can take as a guideline the quite remarkable comment of the English scientist Michael Faraday who, when asked by a politician what good his discoveries in electricity were, answered: "I do not know yet; but some day you will tax it." So it is with national security and technology. Today's laboratory curiosity may be the basis for tomorrow's national defense. No statements of long-term "likely missions" and long-range technological developments will anticipate all of what probably will occur.

The challenge to all of us is to think through the basic requirements of national security for the last third of the 20th century and do what is necessary for our preparedness. This is quite a challenge. To meet this challenge, we need great skill and a sure sense of our responsibilities to the country.

Electronics Component Conference Calls for Papers

The 20th Electronics Components Conference, to be held May 13–15, 1970, at the Statler-Hilton Hotel in Washington, D.C., has called for papers of presentations. The conference, sponsored by the Electronic Industries Association and the Parts, Materials and Packaging Group of the Institute of Electrical and Electronic Engineers, will include sessions on materials, passive components, hybrid integrated circuits, interconnection and packaging, filters and networks, and new functional devices.

Abstracts, with a minimum length of 250 words, along with a list of papers, salient concepts and features, are due by November 15. Four copies of the abstracts should be sent to Darnell P. Burks, Technical Program Chairman, Electronic Components Conference, Sprague Electric Company, Marshall Street, North Adams, Mass. 01247. Authors will be notified of acceptance by January 1, and final manuscripts will be due March 1.

Improved Windshields Sought by Army

Detachable, shatterproof windshields for tracked combat vehicles have been proposed by the Army Combat Developments Command, Fort Belvoir, Va. In addition to providing protection for drivers and commanders in arctic and cold weather climates, the shields would also deflect gravel, dust, water and other substances from the faces of personnel.

The windshields would provide protection from winds from side angles of up to 45 degrees, and would be spring loaded for quick release and mounting. CDC sees the windshields applicable to personnel carriers, tanks and self-propelled artillery pieces.

Weapons To Survive Nuclear Attack

Colonel David R. Jones, USAF

The term "survivability/vulnerability" has recently come into widely accepted use within the Defense Department, and it has special significance when related to nuclear weapons effects. Together, the words imply an awareness of the interplay between employment and design of strategic weapon systems. Separately, and carefully defined, the terms spell out a new philosophy in weapon system development.

The vulnerability of a weapon system to a nuclear environment is defined as the inherent hardness of that system; its ability, because of design, individual components, operating features, etc., to withstand the effects of a nuclear detonation. This hardness may be spelled out as a set of numerical values for the nuclear effects expected to be encountered. If these values are exceeded, the weapon system will be unacceptably degraded in performance. These values are arrived at by experiment and analysis, and are subject to change only when something about the weapon system is changed. Changes may run the gamut from simple substitution of more radiation-resistant electronic components, to the redesign of missile silos to withstand higher overpressures.

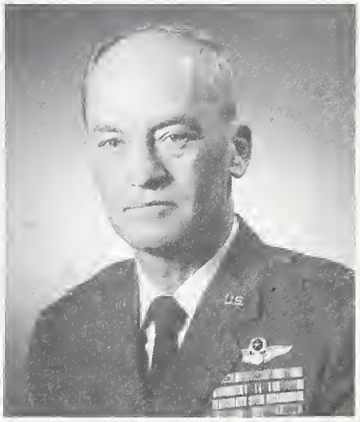
The nuclear survivability of a weapon system may be defined as the capability of that system to perform its designated mission in a nuclear environment. Survivability is a complex term made up of several elements which must be considered individually and in combination with each other. The system planner must decide what kind of a system he wants, what he wants it to do, what it will operate against, and how much money it will take to build it. All of these elements ultimately enter into the survivability calculation. Some of them are highly speculative, and may never be known to a high degree of accuracy. For example, a planner's knowledge of the nuclear threat to a system is limited by inexact information of an enemy's capability and intention. With a completely conservative approach, he might grant the enemy an unwarranted capability and price himself right out of business, trying to design a system to survive in too extreme an environment. In the same way, some nuclear vulnerabilities may not be known to the degree required for careful system design, either because we do not know how to make the required measurements or making them takes a great deal of time and money.

Of the elements involved in the survivability equation, the nuclear threat is undoubtedly the most fluid, but the least adjustable. The mission profile can be adjusted within the limits of the system capability to avoid catastrophic environments, and the system vulnerability can be reduced, at some cost, by design changes or substituting more reliable components. However, the threat is only amenable to better definition. In addition, since the threat is based on the state of technology of a country, it must be treated as a dynamic element because of the constant growth in technology. This necessarily implies that today's system, or one that is being developed to go on the line five years from now, may be obsolete as it comes into the force, if the threat treatment is not adequate.

Elements of Threat and Cost

The other elements of the survivability/vulnerability equation are to a large degree dependent on the threat, but they are also highly sensitive to the element of cost. It may not be possible to harden a system, *i.e.*, reduce its vulnerability to a particular nuclear weapon effect without spending large and, perhaps, prohibitive amounts of money. On the other hand, it may not be necessary, if analysis shows that the system is not going to be exposed to critical levels of that nuclear effect. The mission profile may be designed within the performance limits of the weapon system, to avoid these critical levels. In many cases this cannot be done, and the vulnerability of the weapon system must be reduced in order to achieve a reasonable probability of survival.

Still another method of increasing the chances of survival is the use of countermeasures. These generally have the net effect of reducing the probability of detection and intercep-



Colonel David R. Jones, USAF, has been Director of the Air Force Weapons Laboratory since July 1967. Formerly, he served as the Defense Intelligence Agency's Assistant Chief of Staff for Research and Development. From 1959 to 1963, as Chief of the Physics Division at Kirtland, he played a leading role in developing nuclear explosion effects research programs. Colonel Jones holds a master's degree in nuclear physics.

tion, and act to improve the survivability of the system. Considering all of these elements in the survivability/vulnerability equation, and the uncertainties involved in the highly speculative threat determination, it should be readily apparent that the survivability of a weapon system is not easily determined, especially when the uncertainties in our knowledge of weapon effects are added to the picture.

Effects of Principal Concern

The various nuclear weapon effects that figure in the study of weapon system vulnerability have been well catalogued. Their importance to survivability, however, has not always been appreciated nor understood. Today a much more enlightened attitude prevails, and system planners and project managers are required to consider the nuclear vulnerability of their weapon systems during the design and development phases of the systems. The effects of principal concern are:

• **Ground Shock.** This is the motion induced in the earth by the passage of the air blast from a nuclear detonation, or by directly coupled energy from the detonation. The crater formed by the surface detonation scours out debris which is distributed in the vicinity. All of these are close-in phenomena, and must be considered in examining the vulnerability of hardened sites and complexes.

• **Electromagnetic Pulse (EMP).** EMP is the pulse of electromagnetic radiation resulting from the interaction of nuclear weapon radiation with the atmosphere. Since the rise time is short, it can induce large electric currents in conducting materials, like power lines or missile skins, burning up connectors, damaging components, or introducing spurious signals into computer equipment. Air does not attenuate the EMP environment and the geometrical fall-off with distance is very small. Thus, the EMP environment occupies larger volumes than most weapon effects.

• **X Rays.** These are intense pulses of thermal radiation in the X-ray region of the radiation spectrum which are emitted during the early times of a nuclear detonation. Since these X rays are rapidly absorbed in air, their range in the atmosphere is small. The X-ray environment is of greatest concern in space, where it may well be the dominant kill mechanism for satellites or reentry vehicles.

• **Transient Radiation Effects on Electronic Systems (TREES).** Nuclear particles and radiation from a nuclear detonation can damage or cause malfunctions in electronic components through ionization. Ionization may overload a critical element or create spurious pulses and, thereby, possibly cause system failure.

• **Air Blast.** The rapid and local heating of the air by the nuclear detonation produces a shock wave which rapidly decreases in intensity with distance. Since it is atmosphere dependent, it may be important in vulnerability considerations of aircraft, missiles in the boost phase, and unhardened communications system. As mentioned before, the close-in air blast is important in producing ground shock.

• **Thermal.** Conventional thermal radiation, unlike X rays, is a long-term phenomenon in the history of a nuclear detonation. It is produced by the glowing fireball, and its effect is mainly observed on those systems components which are susceptible to heating over periods as long as a few seconds.

• **Crew Radiation Dose.** This is the radiation dose which the crew receives from the gamma ray and neutron output of a nuclear detonation. It must be specified in terms of total dose and dose rate, since both have been shown to be important. For vulnerability analyses, the dose which incapacitates a crew, rendering it unable to carry out the mission, is of greater importance than the median lethal dose, where there is at least a 50-percent chance that the crew would be able to complete the mission.

• **Blackout.** This may be described as the disruption or disturbance of normal radar communication system operation as the result of interaction of bomb output with the upper atmosphere. The effect tends to be frequency dependent and may last for several days on such things as long-range communications systems, and only a few tenths of a second on some radars.

• **ARGUS.** A nuclear detonation which occurs above the earth's atmosphere injects charged particles, principally electrons, into the earth's magnetic field lines. These are trapped in the field, forming an artificial belt above the Earth. The electrons are gradually removed in collisions with the atmosphere, and the belt decays in intensity. The seriousness of the ARGUS effect on satellites and manned space vehicles is a function of the yield of the weapon detonated and the location of the detonation. Satellite solar cells tend to be particularly vulnerable to electron bombardment.

Threat Level Environment

For each of these effects, a series of threat level environments may be developed which correspond to the enemy threat postulated. The threat level environments developed must be examined for applicability to the weapon system mission profile. For instance, manned aircraft weapon systems are principally vulnerable to air blast, thermal radiation, crew radiation, and TREES, but long-range effects on communications caused by EMP and blackout may also be important. A complete and thorough analysis of the mission profile and threat will reveal which of these effects are important to the system, where in the mission profile they will be encountered, and their relative degree of importance to the successful completion of the mission.

Having determined the complete threat environment in which a system survives, the system developer must find a way to test to that threat level, in order to establish a degree of confidence in the weapon system's survivability. A full-scale nuclear test would provide the opportunity to test in a realistic environment. However, nuclear tests tend to be very costly, complicated, and fraught with many experimental difficulties. The isolation of one effect from all others is very difficult, and the expense of a single test makes repeating a measurement as often as an experimenter would like rather infeasible. Even if full-scale testing was possible, however, it would supplement, in many cases, the simulating techniques currently in use, and would not supplant them. Fortunately, a great deal of progress has been made in developing the weapon effects simulation techniques needed for vulnerability testing. In some cases, a realistic environment may be simulated; in others, the predicted response of the weapon system or a component to that environment may be reproduced.

Search for Simulation Techniques

The need for the development of simulation techniques became apparent with the establishment of the unilateral moratorium on nuclear testing in 1958. Earlier, efforts in the TREES area had led to the use of flash gamma-ray tubes and nuclear reactors, trying to achieve the radiation doses and dose rates necessary for damage studies in electronic components. With the moratorium came the realization that the strategic and defensive posture of the nation would be vitally affected, if means were not found to simulate or reproduce other important nuclear effects. The nuclear effects community is still hard at work on that problem. Megavolt gamma-ray units have since been developed and these, with pulse reactors, give the experimenter an opportunity to study the response on electronics in a realistic environment.

In the X-ray field, in 1959, work was begun on the development of a hydrodynamic computer code to predict X-ray damage to reentry vehicle materials. This was combined with an experimental technique, using flyer plates accelerated by the discharge of condenser banks to study damage mechanisms. Out of this work was obtained a good approximation to the solution of the X-ray problem. In 1952, the first significant effort was made to solve the theoretical problems associated with EMP. These studies ultimately led in 1965 to the development of experimental devices which, by 1967, were capable of producing threat level EMP environments in which the response of whole weapon systems could be realistically tested. In the ground shock area, the high explosive simulation technique (HEST) was developed in 1964. This technique permitted studies of the response of hardened missile site components to ground shock effect. It has since been expanded and is now capable of testing entire segments of complexes. With the growing interest in very hard missile sites, new techniques are being developed to extend the range of overpressures covered by the HEST technique.

The nuclear weapons effects research and technology program of the Defense Department has been the source of most of the simulation technique developments. This program, administered by the Defense Atomic Support Agency and carried out by the laboratories of the Army, Navy and Air Force, falls in the category of exploratory development. In the last few years, as weapon system developers have become increasingly aware of the vulnerability problem, more and more engineering development funds have been available to adapt the simulation techniques to weapon system testing. The trend will probably continue.

Mission of Air Force Weapons Laboratory

Within the Air Force, the Air Force Weapons Laboratory (AFWL) is charged with the responsibility for ensuring that Air Force weapon systems meet hardening criteria. This laboratory, located at Kirtland AFB N.M., manages the Air Force research and technology programs in nuclear weapons effects, including simulation development and participation in underground nuclear tests. In 1967, AFWL was charged with the task of supporting the systems divisions of the Air Force Systems Command (AFSC) in their survivability/vulnerability programs. This has included developing analysis techniques which may be used as guides in system vulnerability studies, developing simulators and testing techniques for measuring system vulnerability, and reviewing engineering changes being incorporated in the system to determine their impact on system vulnerability.

The Air Force Special Weapons Center (AFSWC), also located at Kirtland AFB, has a capability to test weapon systems for vulnerability levels, using the simulation techniques developed by the laboratory. AFSWC provides an analysis capability as well. The two organizations work closely together on survivability/vulnerability problems. An example of this relationship is the HEST series, in which AFSWC took the basic technique for simulating air-induced ground shock as developed by AFWL, and applied it to operational missile sites to check their hardness to ground shock.

A considerable portion of AFSWC and AFWL manpower resources are devoted to the survivability/vulnerability work. In AFWL, 45 percent of over 900 persons assigned are devoted entirely to some aspect of the problem. Most of this investment is concentrated on the major weapon systems managed by the systems divisions of AFSC. In addition, Air Force operating commands, such as the Strategic Air Command and the Aerospace Defense Command, as well as Army and Navy systems offices, are requesting an increasing amount of assistance, especially in the analytical and simulation testing areas.

Fundamental to all of the survivability/vulnerabilty capability at AFWL is its computational techniques and facilities. This capability is manifested in a unique combination of two Control Data Corp. Model 6600 computers, coupled together through an extended core storage, enabling the laboratory to undertake theoretical problems of a complexity unthinkable a few years ago. The essential elements of this computational capability are the people of the laboratory who have learned to develop and adapt complex computer codes, and to solve otherwise intractable problems using these computers.

Continuing Need for Industry Support

Notwithstanding existing capability, AFWL and AFSWC together cannot provide all the analytical and simulation testing work required by the Air Force system program offices (SPOs). There are many weapon systems in the Air Force which must survive in hostile nuclear environments. The degree of severity of these operational environments varies from one system to another. Each of these systems must be examined in the environment in which it will have to operate, and means devised to correct deficiencies where indicated.

Industry offers the only real reservoir of talent to carry out the bulk of the work. This is particularly true in the electronic component problem, where susceptibility to various weapon effects demands very careful fabrication techniques. An education program will have to be established to teach these techniques to the piece-part manufacturer, and quality controls and screening procedures established to upgrade the reliability of each component. This same careful treatment must be applied in other areas as well. The launch control facility in which a misplaced crowbar shorted out a screen, carefully designed to keep out EMP, is a case in point.

There are some effects which have

not been simulated, and possibly never will be, either because the power required is not available or the large-scale effects cannot be satisfactorily reproduced. Response of systems to combined effects, likewise, is difficult to reproduce without full-scale testing. The most cogent argument for full-scale nuclear vulnerability testing, however, lies in the significant difference between nuclear and non-nuclear environments. Unless a great effort is made and much money spent, nuclear vulnerabilities in a system may never be discovered until it is too late. Corrosion, lightning, turbulence, and other non-nuclear environments are lived with on a daily basis, and the operational commands have experience in maintaining their systems in those environments. While the Nuclear Test Ban Treaty makes it more difficult to discover the nuclear vulnerability problems, the simulation program can still provide indispensible effects data.

A great deal remains to be done. To say that the job will ever be completed is to misunderstand the nature of the problem. The continuing objective of AFWL is to promote greater awareness and understanding among the critical organizations—laboratories, system program offices, and industry—of the problems of survivability/vulnerability, and the proper methods for solving them. In achieving this objective, we will be well on our way to more survivable weapon systems and a stronger defense posture.

SAMSO

(Continued from page 5)

vered to a pre-determined landing area like an aircraft; a manned space station to operate at near-synchronous orbit and perform a combination of missions; and a number of alternative methods and equipments for rescue of astronauts from space emergencies, such as explosions, meteroid penetrations, and fire.

Fundamental to advanced planning is the work of the SAMSO Technology Directorate, responsible for using the wide variety of resources available, both within and outside the Government, to identify and attack limiting technologies which prevent achievement of desired operational capabilities. In a broad and active program of exchange of information with Air Force laboratories and industry, the directorate also explores areas of new technology which might result in new and different capabilities.

It conducts extensive study and development work in survivability of missiles and space systems, and is responsible for certain advanced development programs designed to provide the technological building blocks for tomorrow's missile and space systems. Among typical present projects, for instance, is work on improvement of guidance accuracy, hardening of subsystems against nuclear effects, and development of new types of power systems for space vehicles.

The Directorate of Technology is also the agent for the DOD Space Experiments Support Program (SESP), performing integration, engineering and launch services for space experiments approved by DOD. This program provides a kind of "space pickup truck" service to orbit experiments originated outside of the Defense Establishment, but of interest to DOD. Experiments may originate with any organization whose work meets the requirements for DOD approval—the Office of Aerospace Research, National Aeronautics and Space Administration, Atomic Energy Commission, universities, aerospace industries. To date, there have been 7 SESP launches of 12 satellites incorporating 65 experiments. Additional experiments are planned for launch in the future.

The work of the directorate brings into clear focus one of the most vital areas of close interface and cooperation between SAMSO and industry—independent research and development. The directorate keeps in close, active touch with the independent research and development programs of industry, systematically identifying and assessing work which has potential for future missile and space developments. Participating in this DOD program are 114 contractors. More than 80 of them are presently doing work of particular interest to SAMSO.

Our program for evaluation of unsolicated proposals is another evidence of keen and continuing interest in the creative thinking of industry. Every unsolicated proposal submitted to SAMSO is carefully weighed, and a significant number of these—17 in FY 1968—are accepted and funded each year.

We are always keenly aware of the fact that ours is a mission which bristles with unknowns. In addition to internal Air Force resources, we depend upon the research and development skills and resources of industry to supply much of the creative imagination essential to future strengthening of missile defense and expansion of space capabilities.

The progress of the last 15 years conclusively proves the validity of this approach. The Air Force/industry partnership has been productive beyond the most optimistic hopes of the early 1950s. That working relationship has become SAMSO's most valuable single resource for this nation's future in space.

Portable Psy-War Audio-Visual Gear Army Goal

A three-man audio-visual system for disseminating psychological messages to remote areas is under study by the Army. Planned for audiences of from a few to groups of 400, the man-portable system, as seen by the Army Combat Developments Command (CDC), Fort Belvoir Va., would utilize the latest advancements in microminiaturization to permit field employment by small teams.

CDC sees the system consisting of compatible units, elements, modules and subassemblies using principles of unit construction or solid-state techniques. In addition, the system would required high-energy, long-life power sources, allowing increased transmission range and fidelity, while retaining compact size and weight. New techniques in closed circuit TV, long-range image projection, and daylight bright images are being considered by CDC.

The system is planned for use by psychological operations units, civil affairs units, special forces teams and advisory groups in all areas of the world. To meet this requirement, the system must also have airdrop capability.

Special training for the operators should be limited to a short orientation, with little technical skill required, and the system ideally would be compatible with contemporary Army audio-visual aids.

GOVERNMENT PRINTING OFFICE PUBLICATIONS

These publications may be purchased at the prices indicated from:

Superintendent of Documents
Government Printing Office
Washington, D.C. 20402.

Defense Department Procurement Quality Assurance. Guidance to policies and procedures for use by personnel responsible for performing DOD procurement quality assurance functions at contractors' plants. 1969. 131 p. DOD Handbook H57. $1.25.

High Dollar Spare Parts Breakout Program. Establishes DOD uniform policies and procedures relating specifically to procurement of spares and repair parts for use in maintenance, overhaul and repair of equipment and systems. 1969. 87 p. D 101.9:715–22/3. $1.00.

Structural Sandwich Composites, Military Handbook 23A. Includes information on design procedures, fabrication methods, inspection procedures, and repair techniques for both military and commercial flight vehicles. 1969. 420 p. D7.6/2:23A. $3.25.

DEFENSE PROCUREMENT CIRCULARS

Distribution of Defense Procurement Circulars is made automatically by the U.S. Government Printing Office to subscribers of the Armed Services Procurement Regulation (ASPR).

Defense Procurement Circular No. 72, Aug. 7, 1969. (1) Procurement of ADPE, Software, Maintenance and Supplies. (2) Foreign Purchases. (3) Termination Clauses. (4) Revision of Standard Forms. (5) Labor Standards Enforcement Report. (6) Contractors' Plant Shutdowns on 21 July 1969.

Armed Services Procurement Regulation (1969 Edition Revision), No. 4, August 29, 1969. This revision supersedes Defense Procurement Circulars: No. 64, Oct. 28, 1968 (items 5, 8 and 9); No. 65, Dec. 20, 1968 (items 2 and 6); No. 67, Jan. 31, 1969 (item 1); No. 68, March 17, 1969 (items 2, 4 and 6); No. 69, April 30, 1969 (item 4); No. 70, May 29, 1969 (items 1, 5 and 9; and No. 71, June 25, 1969 items 2A and B).

RESEARCH REPORTS

Organizations registered for service may obtain microfiche copies of these documents without charge from:
Defense Documentation Center
Cameron Station
Alexandria, Va. 22314

All organizations may purchase microfiche copies (65¢) or full-size copies ($3) of the documents (unless otherwise indicated) from:
Clearinghouse for Federal and Scientific Information
Department of Commerce
Springfield, Va. 22151

Polyurethane Foams: Technology, Properties and Applications. Picatinny Arsenal, Dover, N.J., Jan. 1969, 257 p. Order No. AD–688 132.

Synthesis of Carbonate and Amine Modified Polyether Elastomers. U.S. Army Weapons Command, Rock Island, Ill., March 1969, 18 p. Order No. AD–687 252.

Rare-Earth Oxide Radiators for Thermo-Photovoltaic Energy Conversion. U.S. Army Electronics Command, Fort Monmouth, N.J., April 1969, 24 p. Order No. AD–688 088.

Recent Developments in Pyrolytic Graphite. Army Materiels and Mechanics Research Center, Watertown, Mass., March 1969, 19 p. Order No. AD–688 074.

Interaction of Water Vapor with Pristine E-Glass Fiber. Naval Research Laboratory, Washington, D.C., Dec. 1968, 25 p. Order No. AD–686 377.

Summary of Specification Requirements for Military Fabrics. Test Development Branch, U.S. Army Natick Laboratories, Natick, Mass., Oct. 1968, 383 p. Order No. AD–680 231.

Evaluation of Experimental Safety Fuels in a Conventional Gas Turbine Combustion System. Naval Air Propulsion Test Center, Philadelphia, Pa., April 1969, 33 p. Order No. AD–686 840.

Quantitative Mixed Solvent Analysis by Infrared Spectrophotometry. U.S. Army Coating and Chemical Laboratory, Aberdeen Proving Ground, Md., May 1969, 27 p. Order No. AD–688 588.

Solubility of Nickel in Liquid Sodium of High Oxide Content. Naval Research Laboratory, Washington, D.C., May 1969, 17 p. Order No. AD–688 780.

Energy Distribution in an Optimum Structural Design. Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio, March 1969, 70 p. Order No. AD–688 489.

Doping of Semiconductors and Semiconducting Films. Defense Documentation Center, Alexandria, Va., May 1969, 140 p. Order No. AD–687 900.

Magnetoelectric Effects in Semiconductor Junctions. U.S. Army Electronics Command, Fort Monmouth, N.J., April 1969, 28 p. Order No. AD–688 087.

Oil-Contaminated, Solid-Film, Lubricated Surfaces—New Concept. U.S. Army Weapons Command, Rock Island, Ill., April 1969, 22 p. Order No. AD–687 254.

Improving the Efficiency of Bonded Solid Film Lubricants. U.S. Army Weapons Command, Rock Island, Ill., March 1969, 24 p. Order No. AD–687 256.

The Measurement of Dynamic Properties of Materials Using a Transfer Impedance Technique. Naval Ship Research and Development Center, Washington, D.C., April 1969, 39 p. Order No. AD–688 786.

Superconducting Line Diodes: Some Preliminary Observations. Naval Civil Engineering Laboratory, Port Hueneme, Calif., May 1969, 19 p. Order No. AD–688 104.

Fuel Supplier for Worldwide U.S. Military Activities

Rear Admiral F. W. Martin Jr., SC, USN

The Defense Department's responsibility for procurement of fuel, lubricants and petroleum services to all U.S. military activities throughout the world, as well as for non-military government activities in the United States and its possessions, is assigned to the Defense Fuel Supply Center (DFSC). The center, located at Cameron Station, Alexandria, Va., is a field activity of the Defense Supply Agency (DSA).

Unlike other DSA supply centers, DFSC does not manage inventories nor budget for funds to pay for the goods and services it procures. First and foremost, DFSC is a procurement activity, with annual contract awards currently running near the $1.8 billion level. Secondly, DFSC is a coordinator of distribution for petroleum fuels which must be moved by ocean tanker—almost 180 million barrels in FY 1969.

Perhaps the best indicator of the magnitude of the task is the following fact: The entire economy of the United States, by far the world's largest consumer of petroleum products, could be sustained for a full month by the gallonage included in the annual DFSC petroleum buy.

Development of Military Petroleum Management

It would seem, then, that the military importance of petroleum needs no emphasis. Yet this was not always so—and not too long at that. It was not until 1942, after Pearl Harbor, that the need for a degree of centralized control of military petroleum supply was recognized. Recognition of that need led to the creation of the Amy-Navy Petroleum Board (ANPB) as an agency of the Munitions Board to "Coordinate the supply and distribution of petroleum products to the U.S. Military and our allies."

ANPB, although not itself a procurement activity, did initiate the central coordination of ocean tanker distribution. It also pointed the way towards the eventual establishment of centralized petroleum procurement, which found its genesis in the National Defense Act of 1947, and the resultant creation in 1948 of the Armed Services Petroleum Procurement Agency (ASPPA) as a DOD activity. Thus, for the first time, common Army, Navy, Air Force and Marine Corps requirements were satisfied by consolidated procurement actions. ASPPA also assumed the ANPB mission of coordinating the worldwide ocean tanker distribution mission, and became the organizational grandparent of today's DFSC.

The next important evolutionary development of petroleum management occurred in 1956, when the need for greater centralization of logistic support led to the "single manager" concept. In effect, that concept handed to one Military Service full responsibility for the supply of an homogeneous group of common supply items for all the Services. ASPPA was reorganized and given an expanded mission, including functions in the areas of cataloging, standardization, procurement inspection, training and procurement of commercial storage, testing and refueling services. Renamed the Military Petroleum Supply Agency (MPSA), it became an activity under control of the Navy. At that time a decision was made to deviate from the basic single manager concept and retain petroleum inventory ownership and funding responsibility in the individual Military Services, a policy which continues today.

In 1962, concurrent with its transfer to the newly established Defense Supply Agency, MPSA was renamed the Defense Petroleum Supply Center (DPSC) and, for a short time, had an inventory management role. The new responsibility was limited to lubricants and miscellaneous packaged petroleum items, plus certain chemicals and gas cylinders. Procurement of coal was added to DPSC's responsibilities in 1963, leading to the

Rear Admiral F. W. Martin Jr., SC, USN, has been Commander of the Defense Fuel Supply Center of the Defense Supply Agency since November 1966. Prior to this command, he was Deputy Commander for Planning and Policy, Naval Supply Systems Command. Admiral Martin holds a B.A. degree from the University of Washington, and an M.B.A. from the Graduate School of Business, Stanford University.

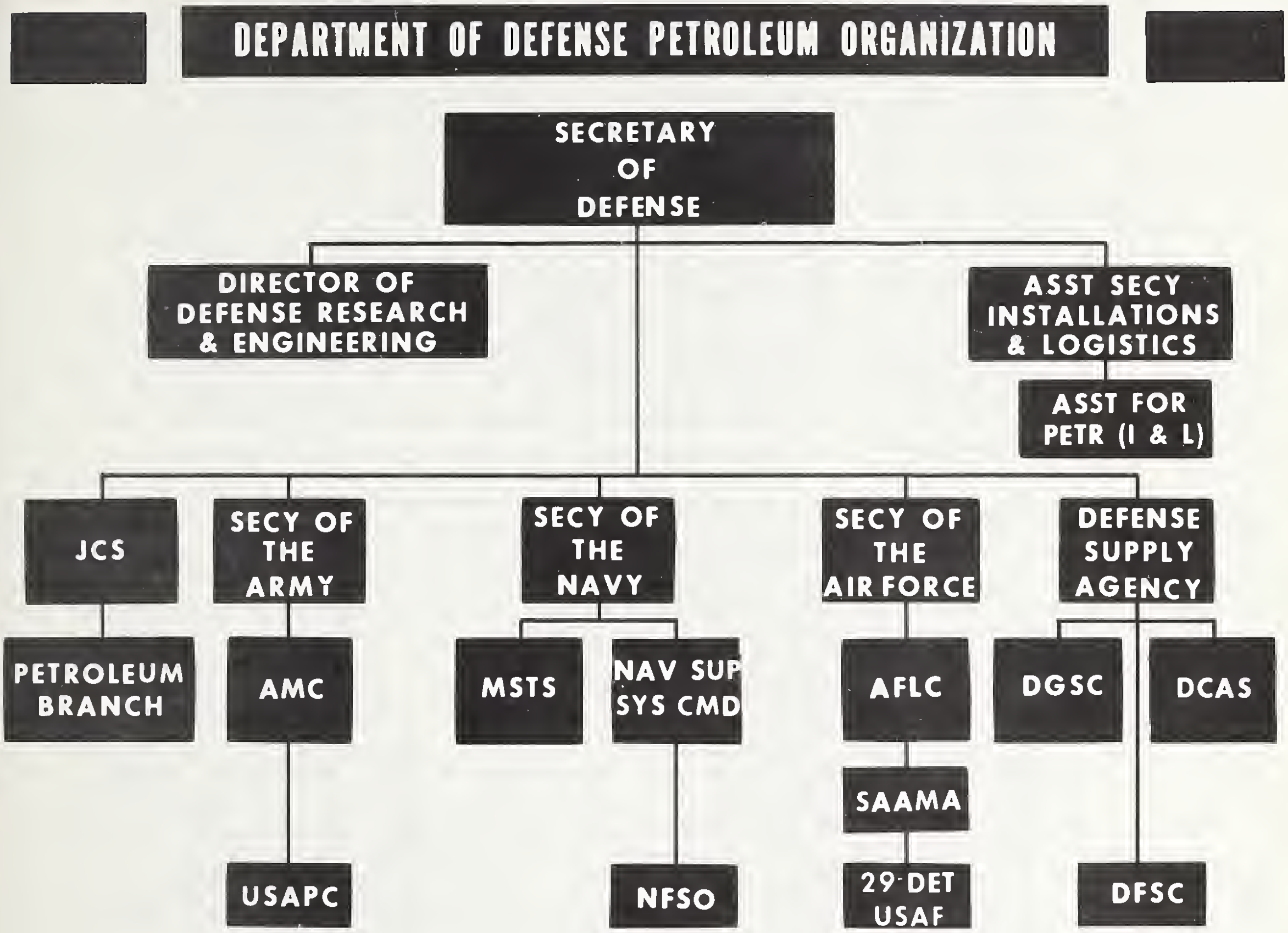


Figure 1.

ubstitution of "Fuel" for "Petroleum" in the center's name—thus, it became the Defense Fuel Supply Center. It was not long (early 1965) before it became apparent that the limited management functions could be handled more efficiently by a "conventional" supply center, rather than at DFSC with its primary orientation towards procurement and the distribution of bulk petroleum. The supply management function was transferred to the Defense General Supply Center, located at Richmond, Va., taking with it cataloging and standardization responsibilities.

Organization

Organizationally, DFSC is composed of five staff elements and three operational directorates, all of which report directly to the commander. The staff elements—counsel, planning and management, contract review, technical services, and small business—perform advisory and specialized functions for the commander, and support the operations directorates which do the real work—buying and moving the product. The center is authorized 16 military and 194 civilian personnel, and operates on an annual budget of about $2.25 million.

The worldwide military petroleum logistic organization is a complex of many elements. Figure 1 illustrates where DFSC fits into the overall DOD organization, and identifies other major elements involved in the petroleum logistic mission.

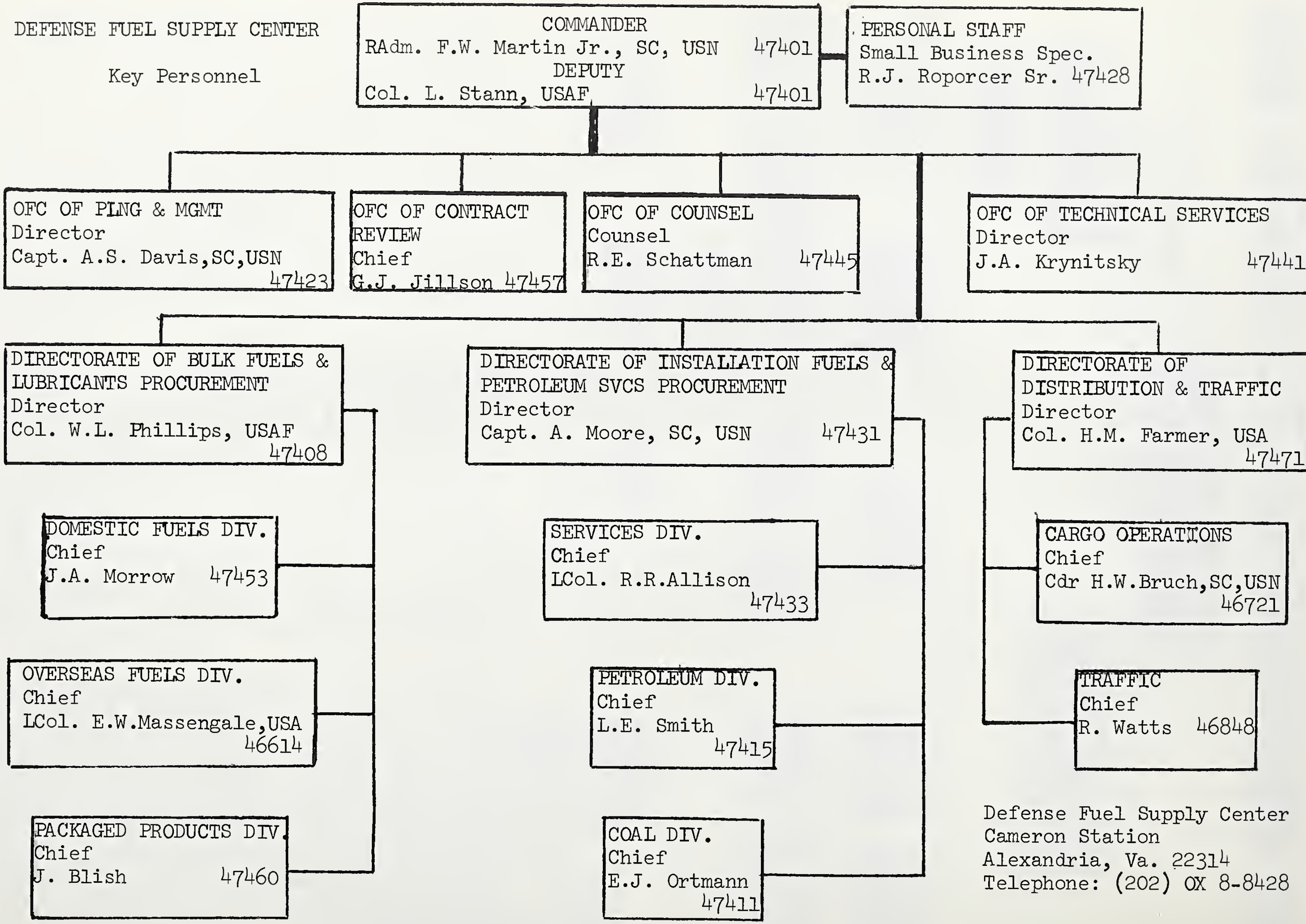
Procurement Mission

Fundamentally, DFSC's relations with other activities are built around the two principal missions already discussed—procurement and distribution. Looking first at procurement, requirements for petroleum fuels and coal are developed at the consuming level in each Service, and move upwards through consolidating levels to the inventory control points (ICPs). The ICPs, the Military Service petroleum inventory managers, collocated with DFSC at Cameron Station, submit their consolidated requirements to DFSC in accordance with published procurement program schedules. These schedules establish when procurement will occur for each product in each geographical area, as well as the delivery period which will be covered by the awards under each program. Selected civil activities submit their unconsolidated requirement direct to DFSC, also in accordance with the schedules.

Packaged petroleum procurement requirements, mostly lubricants and greases, come from the Defense General Supply Center (DGSC) for maintenance of depot inventories managed by that center. Other re-

DEFENSE FUEL SUPPLY CENTER

Key Personnel



Defense Fuel Supply Center
Cameron Station
Alexandria, Va. 22314
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quirements for lubricants, which can be supplied to customers direct from commercial sources, bypass DGSC and come directly to DFSC from the consuming activities. Requirements for storage, refueling, and other services generally come from military ICPs.

The great majority of these requirements, consisting of bulk liquid petroleum products and packaged items for direct delivery to customers, are procured on an indefinite quantity basis. The customer (whether civil activity, individual military base, overseas command, or, in the case of the larger bulk requirements, the ICP) is, in fact, the buyer—the man who actually gives the contractor a funded delivery order for a specific quantity of an item or service under the terms of the appropriate DFSC contract. On the other hand, packaged lubricants for DGSC depot stock, and for most Services, are procured in fixed quantity, funded contracts for delivery in accordance with schedules included in the contracts—much as most non-petroleum supplies are procured by other DSA supply centers.

DFSC has the responsibility for worldwide procurement of fuel, including deliveries into some rather remote installations and sometimes under unusual circumstances. Each year contracts are awarded in over 90 countries or territories all over the world, close to 90 percent of all dollar awards are made on a competitive basis, over 45 percent of all awards result from use of the formal advertising process, and more than 23 percent of all procurement in the United States is given to small business.

Worldwide Distribution

While coal and lubricants are important elements in the DFSC mission, bulk liquid petroleum fuels constitute well over 90 percent of the total dollar value of the center's awards. Bulk fuels are vital commodities to the Armed Forces, and the worldwide distribution procedures require close coordination to ensure adequate supplies at all times. DFSC is assigned the responsibility for this coordination with the refineries, Military Sea Transportation Service (MSTS), and the military customers.

Bulk supplies in the United States which move overland by pipeline, rail, or highway are ordered direct from the refineries according to DFSC contracts, as needed. The same procedure is followed in overseas areas where DFSC contracts have been placed with local oil companies. However, bulk fuel requirements, which must be moved by ocean tanker, require a system of scheduling which will preclude any possibility of supply breakdown even with the long lead times involved.

The overseas unified commands, through the staff joint petroleum offices, consolidate the requirements of all Army, Navy, Air Force and Marine Corps forces in their command area, and submit them to DFSC monthly on a document called the "slate." The Military Service ICPs make up slates for tanker-supplied product in the United States, as well as supplying the funds to pay for the fuel. The Military Sea Transportation Service provides the tankers in the right size for each job at the time and place required. The tankers come from the MSTS fleet or, if necessary, are chartered.

The monthly slate, which DFSC receives from each of the five overseas unified commands and the three ICPs, lists requirements for each product over a five-month period, and shows how much is needed at specific locations at specific times. The contracts to provide these products have been previously awarded by DFSC. It is necessary to coordinate the activities of the refinery, the shipping terminal, the MSTS ships, and the receiving terminal. Approximately 80 to 85 ships load in an average month with more than 15 million barrels of fuel, and the loading ports are in such diverse locations as Texas, Pennsylvania, California, Venezuela, France, Japan, Saudi Arabia, England and Italy. The destinations are also worldwide.

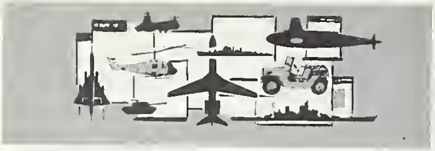
The scheduling is often complicated by having to load two or more products from different terminals and from having multiple discharge ports. Advanced planning is necessary as the destination can be as much as 14,000 miles and 37 days away. Extreme care must be taken to ensure that DFSC scheduling does not cause delays, as a single day demurrage on a tanker will cost from $4,000 to $12,000.

Specification Requirements

Inherent in any supply system is a need for assurance that the supplies meet specifications—that they will do the job they are intended to do. There are few areas where quality assurance is more important than it is in the procurement and delivery of petroleum. Faulty products, fuel or lubricants, can cause engine failure and possible loss of a multi-million dollar airplane and its human cargo; they can cause mechanical failure or excessive maintenance in ships' engines and boiler rooms; they can stop armored units in the field. Products must be inspected on delivery, and repeatedly throughout the distribution system, to ensure that they are and remain in compliance with specification requirements. Quality assurance representatives around the world do the job in accordance with DFSC-developed procedures. DFSC technical personnel also assist Military Service technicians in the field on day-to-day quality maintenance problems. Additionally, they play an important role in maintaining a broad base of supply by reviewing specifications to ensure that they are not so restrictive as to limit the number of refiners who will offer the items for sale.

Other functions performed by DFSC include the administration of the military's allocation for the import of petroleum under the Mandatory Oil Import Control Program, administration of the Defense Department's program to reduce the adverse international balance of payments insofar as it pertains to petroleum, and the coordination of petroleum industry training for civilian and military personnel of the Government. This latter function involves DFSC in a continuing cooperative effort with the American Petroleum Institute and member companies which sponsor semi-annual indoctrination courses for selected personnel, who will be concerned with petroleum in their daily work, and in fostering mutual understanding between government and industry personnel.

That is the story of the Defense Fuel Supply Center. It is a small organization with a very big job. The people who man DFSC know full well that, in the final analysis, they are part of a worldwide team of players from the Military Services, civilian government agencies and private industry. It is the cooperative, coordinated performance of the whole team that makes DFSC's success possible.



DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of August 1969.

DEFENSE SUPPLY AGENCY

4—**B.V.D. Co., Inc.**, New York, N.Y. $1,250,-658. 3,299,160 men's crewneck white cotton undershirts. Mullins Textile Mills Co., Mullins, S.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0211.

5—**Choctaw Manufacturing Co., Inc.**, Silas, Ala. $1,205,809. 528,000 pairs of Navy enlisted men's white trousers. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0238.

8—**Safety First Shoe Co., Inc.**, Nashville, Tenn. $3,855,054. 456,760 pairs of men's leather combat boots. Huntsville, Ala. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0266.

—**J. H. Rutter Rex Manufacturing Co.**, New Orleans, La. $1,098,402. 492,040 pairs of Air Force men's cotton twill trousers. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0257.

—**Dana Corp.**, Taylor, Mich. $6,076,031. 1,542,140 steel helmets. Trenton, Mich. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0252.

11—**Standard Oil Co. of Calif.**, San Francisco, Calif. $1,083,600. 200,000 barrels of marine diesel fuel oil for delivery to Barbers Point, Oahu, Hawaii. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-D-0234.

15—**International Harvester Co.**, Melrose Park, Ill. $2,632,499. Tractors. Chicago, Ill. Defense Construction Supply Center, Columbus, Ohio. DSA 700-70-C-8054.

—**U & W Industries, Inc.**, Selma, Ala. $1,-128,050. 1,128,400 men's cotton sateen shirts. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0322.

19—**C. M. London Co.**, New York, N.Y. $1,117,-231. 1,190,000 linear yards of water repellent polyester and cotton poplin cloth, Army green. Chesnee, S.C., and Trion, Ga. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0365.

21—**Tanenbaum Textiles Co., Inc.**, New York, N.Y. $1,204,342. 746,000 yards of wind-resistant oxford cotton cloth. Lewiston, Maine, and Clevedale, S.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0372.

—**J. P. Stevens and Co., Inc.**, New York, N.Y. $1,197,630. 750,000 yards of wind-resistant oxford cotton cloth. Whitmore and Wallace, S.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0373.

27—**West Point Pepperell, Inc.**, New York, N.Y. $1,437,885. 1,941,000 yards of cotton duck cloth. Anderson, S.C., Langdale, Ala., and Memphis, Tenn. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0331.

28—**La Crosse Garment Manufacturing Co.**, La Crosse, Wis. $1,757,482. 138,132 mountain sleeping bags. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0395.

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—Company — Value — Material or Work to be Performed—Location of Work Performed (if other than company plant) — Contracting Agency—Contract Number.

DEPARTMENT OF THE ARMY

1—**Dravo Corp.**, Bellevue, Wash. $13,318,001. Construction of the main dam and facilities for up-stream fish passage, and roads at the Wynoochee Dam, Wash. Army Engineer District, Seattle, Wash. DA-CW67-70-C-0005.

—**Oman Construction Co., Inc.**, Nashville, Tenn., and **Codell Construction Co., Inc.**, Winchester, Ky. $11,211,450. Construction of Stage II, Laurel Dam, Laurel and Whitley Counties, Ky. Army Engineer District, Nashville, Tenn. DA-CW62-70-C-0008.

—**Philco Ford Corp.**, Newport Beach, Calif. $2,700,000 (contract modification). Phase II of the Fair Measurement Program. Newport Beach and Palo Alto, Calif. Safeguard System Command, Huntsville, Ala. DA-HC60-69-C-0085.

—**Pacific Car and Foundry Co.**, North Renton, Wash. $3,045,500. M116A1 amphibious cargo carriers and XM733 full tracked amphibious assault vehicles. Army Tank Automotive Command, Warren, Mich. DA-AE07-70-C-0079.

4—**Donovan Construction Co.**, New Brighton, Minn. $2,247,200 (contract modification). Metal parts for 155mm high explosive projectiles. Twin Cities Army Ammunition Plant, New Brighton, Minn. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0036.

5—**R. M. Wells**, Quanah, Tex. $3,205,000. Construction of an addition to an existing hospital, Sheppard AFB, Tex. Army Engineer District, Albuquerque, N.M. DA-CA47-70-C-0010.

—**White Motor Corp.**, Lansing, Mich. $5,133,-483 (contract modification). M602 series 2½ ton trucks. Project Manager, General Purpose Vehicles, Warren, Mich. DA-AE06-69-C-0003.

—**Hughes Tool Co.**, Culver City, Calif. $1,-598,000. Disassemble, inspect and repair 47 crash-damaged OH-6A helicopters. El Segundo, Calif. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-68-A-0017.

—**Guy H. James Construction Co.**, Oklahoma City, Okla. $1,751,031. Construction and associated work at the DeGray Dam and Reservoir Project, Caddo River, Ark. Army Engineer District, Vicksburg, Miss. DA-CW38-70-C-0030.

6—**Pace Corp.**, Memphis, Tenn. $1,524,250 (contract modification). Ground illumination signals (white star cluster parachute). Picatinny Arsenal, Dover, N.J. DA-AA21-69-C-0384.

8—**Logistics Management Institute**, Washington, D.C. $1,300,000 (contract modification). 24 professional man-year effort in fact-finding analytical studies in logistics management. Defense Supply Service, Washington, D.C. SD-271.

11—The Army Aviation Systems Command, St. Louis, Mo., awarded the following contracts for maintenance support, modifications and crash/battle damage repairs for Army aircraft in South Vietnam:

Dynaelectron Corp., Fort Worth, Tex. $9,139,380. DA-23-204-AMC-04022(T).

Lear Siegler, Inc., Oklahoma City, Okla. $7,682,573. DA-23-204-AMC-04023(T).

Lockheed Aircraft Corp., Midwest City, Okla. $3,008,047. DA-23-204-AMC-04024 (T).

13—**Sovereign Construction Co., Ltd.**, Fort Lee, N.J. $15,830,000. Construction of two cadet barrack buildings, U.S. Military Academy, West Point, N.Y. Army Engineer District, New York, N.Y. DA-CA51-70-C-0014.

—**Martin Marietta Corp.**, Orlando, Fla. $1,-493,800 (contract modification). System component test stations for the Pershing missile. Army Missile Command, Redstone Arsenal, Ala. DA-AH01-69-C-1534.

15—**Robert E. McKee General Contractor, Inc.**, El Paso, Tex. $15,862,000. Construction of a 12-story general hospital. Army Engineer District, Albuquerque, N.M. DA-CA47-70-C-0011.

—**Pace Corp.**, Memphis, Tenn. $8,827,000 (contract modification). Ground illumination signals. Memphis and Camden, Ark. Picatinny Arsenal, Dover, N.J. DA-AA21-69-C-0519.

—**AVCO Corp.**, Stratford, Conn. $7,308,312 (contract modification). T53-L-13A gas turbine engines. Stratford and Charleston, S.C. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-68-C-1874.

—**Motorola, Inc.**, Scottsdale, Ariz. $1,900,000. SM596 fuzes for 40mm shells. Harry Diamond Laboratories, Washington, D.C. DA-AG39-70-C-0156.

—**Lasko Metal Products, Inc**, West Chester, Pa. $1,639,512 (contract modification). SUU-14A/A bomb dispensers. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0156.

—**Sperry Rand Corp.**, Phoenix, Ariz. $1,-267,302. AN/ASN-43 gyro-magnetic compass sets. Phoenix and Durham, N.C. Los Angeles Procurement Agency, Pasadena, Calif. DA-AG07-69-C-0436.

—**Chris Berg, Inc.**, Seattle, Wash. $1,131,-958. Construction of NCO open mess building and necessary utilities, Fort Lewis, Wash. Army Engineer District, Seattle, Wash. DA-CA67-70-C-0004.

—**Western Electric Co.**, New York, N.Y. $7,877,914. Continuation of training aids engineering for the Safeguard Ballistic Missile Defense System. Safeguard System Command, Huntsville, Ala. DA-HC60-69-C-0010.

18—**Baldwin-Lima-Hamilton Corp.**, Philadelphia, Pa. $1,093,098. Design, manufacture, delivery and installation of a 98,000 horsepower hydraulic turbine, plus spare parts. Eddystone, Pa., and Laurel River Reservoir Project, Ky. Army Engineer District, Nashville, Tenn. DA-CW62-70-C-0012.

—**Baltimore Contractors, Inc.**, Baltimore, Md. $6,594,000. Construction of a two-story laboratory, administration and medical building, Fort Detrick, Md. Army Engineer District, Baltimore, Md. DA-CA31-70-C-0008.

20—**Bell Aerospace Corp.**, Fort Worth, Tex. $6,720,000. Crash-worthy fuel cell modification kits for UH-1 helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.

22—**Varo, Inc.**, Garland, Tex. $1,179,604. Two-year procurement contract for 40mm image intensifier assemblies. Army Electronics Command, Procurement Division, Fort Monmouth, N.J. DA-AB07-69-C-0368.

—**Weatherhead Co.**, Cleveland, Ohio. $3,-573,300. Metal parts for 105mm projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0010.

25—**Hughes Tool Co.**, Culver City, Calif. $1,-660,131. Tail rotor hubs and blade assemblies for OH-6 helicopters. Army Aviation Systems Command, St. Louis, Mo. DA-23-204-AMC-03697(T).

26—**Chrysler Motors Corp.**, Warren, Mich. $2,307,338. Cargo trucks and ambulances.

Army Tank Automotve Command, Warren, Mich. DA-AE07-70-C-0106.

—**Bell Aerospace Corp.**, Fort Worth, Tex. $2,005,091. Rotor hub assemblies for UH-1 helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.

—**Boeing Co.**, Morton, Pa. $1,455,651. Ground support equipment for CH-47 helicopters. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-68-A-0005.

—**J. I. Case Co.**, Racine, Wis. $1,065,534 (contract modification). Loaders. Racine, Terre Haute, Ind., and Burlington, Iowa. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-69-C-A817.

27—**LTV Aerospace Corp.**, Honolulu, Hawaii. $11,135,000 (contract modification). Operation, maintenance and development of Kwajalein Missile Range technical facilities for 12 months. Kwajalein, Marshall Islands. Safeguard System Command, Huntsville, Ala. DA-HC60-69-C-0003.

—**Electro-Optical Systems, Inc.**, Pasadena, Calif. $1,899,630. AN/TVS-4 nigbt vision sights. Pomona, Calif. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-68-C-0190.

29—The Army Ammunition Procurement and Supply Agency, Joliet, Ill., issued the following contracts:

Batesville Manufacturing Co., Batesville, Ark. $8,098,200. Metal parts for M904E2 bomb nose fuzes. DA-AA09-70-C-0015.

Raytheon Co., Lexington, Mass. $6,975,-150. Metal parts for M905 bomb tail fuzes. DA-AA09-70-C-0017.

Eureka Williams Corp., Bloomington, Ill. $4,367,436. Metal parts for M904-E2 bomb nose fuzes. DA-AA09-70-C-0016.

Stewart-Warner Corp., Indianapolis, Ind. Metal parts for M148 booster adapters less sleeves. DA-AA09-70-C-0030.

U.S. Components Corp., Bloomfield, Mich. $1,102,500. Metal parts for M148 booster adapters less sleeves. DA-AA09-70-C-0031.

—The Army Tank Automotive Command, Warren, Mich., issued the following contract modifications:

White Motor Corp., Lansing, Mich. $2,-018,320. Engineering services for 5-ton trucks. DA-AE07-67-C-5043.

Ford Motor Co., Dearborn, Mich. $1,-990,500. Engineering support for 5-ton trucks. DA-AE07-68-C-0445.

AVCO Corp., Stratford, Conn. $1,464,-000. Design, develop, test and fabricate AGT-1500 turbine engines. DA-AE07-70-C-0082.

—**Guy James Construction Co.**, Oklahoma City, Okla. $6,698,692. Construction of a dam and associated work, two miles south of Farmer, Ky. Army Engineer District, Louisville, Ky. DA-CW27-70-C-0013.

—**Hensel Phelps Construction Co.**, Greeley, Colo., and **Penner Construction Co.**, Denver, Colo. $3,097,000. Aerospace Data Processing Facility, Buckley Air National Guard Base, Colo. Army Engineer District, Omaha, Neb. DA-CA45-70-C-0015.

—**Raytheon Co.**, Andover, Mass. $2,000,008 (contract modification). Engineering services for the Improved Hawk missile system. Andover and Bedford, Mass., and White Sands Missile Range, N.M. Army Missile Command, Redstone Arsenal, Ala. DA-AH01-69-C-0099.

—**Bethlehem Steel Corp.**, Bethlehem, Pa. $1,959,966. Gun tube forgings for 175mm guns. Watervliet Arsenal, Watervliet, N.Y. DA-AF07-69-C-0257.

—**Raytheon Co.**, Waltham, Mass. $1,059,331. Magnetron tubes for the Nike missile system. Army Missile Command, Redstone Arsenal, Ala. DA-AH01-70-C-0247.

—**Bell Aerospace Corp.**, Fort Worth, Tex. $9,330,000. UH-1N helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-70-C-0205.

—**Honeywell, Inc.**, Hopkins, Minn. $1,497,-500. Phase I component development of a three phase program covering design and development of an Area Denial Artillery Munitions. Picatinny Arsenal, Dover, N.J. DA-AA21-70-C-0096.

—**Hughes Aircraft Co.**, Culver City, Calif. $9,185,848. Engineering services and support of the TOW missile. Culver City and Tucson, Ariz. Army Missile Command, Redstone Arsenal, Huntsville, Ala. DA-AH01-70-C-02909.

DEPARTMENT OF THE NAVY

1—**General Electric Co.**, Cincinnati, Ohio. $1,810,000. Overhaul kits for maintenance of J79-GE-8 engines. Naval Aviation Supply Office, Philadelphia, Pa. F34601-69-A-1029-GB56.

—**North American Rockwell Corp.**, Anaheim, Calif. $1,216,000. Operation and maintenance of Mark II Ships Inertial Navigation System in-house equipment, FY 1970. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5010.

4—**Hughes Aircraft Co.**, Culver City, Calif. $13,400,000 (contract modification). FY 1970 funding for the Phoenix missile system. Culver City, Canoga Park and El Segundo, Calif. Naval Air Systems Command, Washington, D.C. N00019-67-C-0240.

—**Bendix Corp.**, Baltimore, Md. $6,845,498 (contract modification). Increase in limitation of authorization for AN/APX-72 transmitters and associated equipment for the Army. Naval Air Systems Command, Washington, D.C. NOw 66-0037.

—**Sparton Corp.**, Jackson, Mich. $5,589,373. AN/SSQ-47B sonobuoys. DeLeon Springs, Fla. Naval Air Systems Command, Washington, D.C. N00019-70-C-0055.

—**Uniflite Corp.**, Bellingham, Wash. $1,-089,489. Construction of twenty-three 31-foot river patrol boats (PBR). Naval Ship Systems Command, Washington, D.C. N00024-70-C-0211.

5—**United Aircraft Corp.**, East Hartford, Conn. $3,536,640 (contract modification). Design and development of the J-52-P-408 engine. Naval Air Systems Command, Washington, D.C. N00019-69-C-0299.

—**Whittaker Corp.**, Saugus, Calif. $1,961-232. Aircraft parachute flares, Mk 24 Mod 4. Naval Ships Parts Control Center, Mechanicsburg, Pa. N000104-69-C-0154 P009.

—**Fulghum and Hinman, Inc.**, Pensacola, Fla. $2,400,000. Construction of a consolidated plating facility, Naval Air Rework Facility, Pensacola. Naval Facilities Engineering Command, Washington, D.C. N62467-67-C-0730.

6—**McDonnell Douglas Corp.**, St. Louis, Mo. $11,100,000 (contract modification). Long lead time effort for Air Force RF-4E aircraft. Naval Air Systems Command, Washington, D.C. N00019-68-C-0495.

—**Kaman Aircraft Corp.**, Bloomfield, Conn. $4,739,902. Conversion of UH-2A/B helicopters to C configuration. Naval Air Systems Command, Washington, D.C. N00019-70-C-0051.

—**Aero Corp.**, Lake City, Fla. $2,766,224 (contract modification). Progressive aircraft rework on P-2 series aircraft. Naval Air Systems Command, Washington, D.C. N00019-69-C-0136.

—**General Dynamics Corp.**, Pomona, Calif. $1,655,295 (contract modification). Research and development on the Standard ARM missile. Naval Air Systems Command, Washington, D.C. N00019-68-C-0400.

7—**Lockheed Missile and Space Co.**, Sunnyvale, Calif. $2,612,553. Engineering services for Polaris reentry systems. N00030-70-C-0050. $3,750,000. Repair of Polaris equipment. N00030-70-C-0057. Naval Strategic Systems Project Office, Washington, D.C.

8—**General Dynamics Corp.**, Pomona, Calif. $2,662,130. Engineering services for the advanced development model of a close-in weapon control system. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-4235.

—**James E. Cox Construction Inc.**, Charlotte, N.C. Construction of aircraft maintenance shops, Marine Corps Air Station, Cherry Point, N.C. Naval Facilities Engineering Command, Washington, D.C. N62470-68-C-0974.

11—**Grumman Aerospace Corp.**, Bethpage, N.Y. $107,600,000 (contract modification). Incremental funding for F-14A weapons systems. Naval Air Systems Command, Washington, D.C. N00019-69-C-0422.

—**Spartan Corp.**, Jackson, Mich. $3,828,092 (contract modification). AN/SSQ-41A sonobuoys. DeLeon Springs, Fla., and Jackson. Naval Air Systems Command, Washington, D.C. N00019-69-C-0495.

—**FMC Corp.**, Minneapolis, Minn. $3,111,-375. Component parts for 5 inch 54 caliber gun mounts. Naval Ordnance Station, Louisville, Ky. N00197-70-C-0065.

—**Sperry Rand Corp.**, Long Island, N.Y. $2,902,000. Engineering services for Ships Inertial Navigation Systems during Poseidon conversion of seven nuclear powered fleet ballistic submarines (SSBN). Newport News, Va., Groton, Conn., Vallejo, Calif., Bremerton, Wash., and Portsmouth, N.H. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5372 P001.

—**Bethlehem Steel Corp.**, Terminal Island, Calif. $1,694,201. Regular overhaul of the USS Passumpsic (AO-107). Supervisor of Shipbuilding, Conversion and Repair, Eleventh Naval District, Long Beach, Calif. N62791-70-B-0002.

12—**Raytheon Co.**, Sudbury, Mass. $20,000,000. Poseidon guidance system electronics assembly requirements. Waltham, Mass. Naval Strategic Systems Project Office, Washington, D.C. N0030-70-C-0005.

—**Interstate Electronics Corp.**, Anaheim, Calif. $2,987,000. Poseidon missile test instrumentation. N00030-69-C-0123 PZ01. $1,876,000. Poseidon test and evaluation equipment. N00030-70-C-0084. Naval Strategic Systems Project Office, Washington, D.C.

—**McDonnell Douglas Corp.**, St. Louis Mo. $4,800,000 (contract modification). Long lead time effort for F-4J aircraft. Naval Air Systems Command, Washington, D.C. N00019-68-C-0495.

—**PRD Electronics, Inc.**, Jericho, N.Y. $2,096,100 (contract modification). VAST (Versatile Avionics Shop Test) building blocks and data transfer units. Naval Air Systems Command, Washington, D.C. N00019-68-C-0449.

—**Thiokol Chemical Corp.**, Elkton, Md. $2,-116,938 (contract modification). Pilot production of rocket motors for the ZAP missile. Naval Ordnance Laboratory, White Oak, Md. N60921-68-C-0168 P013.

13—**General Electric Co.**, Schenectady, N.Y. $28,872,000. Nuclear propulsion research and development. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5027.

—**General Dynamics Corp.**, Quincy, Mass. $1,491,370. Design work for nuclear propulsion plants. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5033.

15—**Honeywell, Inc.**, Hopkins, Minn. $2,612,-291. Manufacture of complete sets of low-speed fuel air explosive (FAE) components, less dispenser and bomb fusing. Naval Purchasing Office, Los Angeles, Calif. N00123-69-C-0281.

—**Texas Instruments, Inc.**, Dallas, Tex. $1,-396,924. Spare parts for forward looking radar system (APQ-126) for A-7E aircraft. Aviation Supply Office, Philadelphia, Pa. N00383-69-A-1801-0085.

18—**Bendix Corp.**, Teterboro, N.J. $4,000,000. Inertial components for Poseidon missiles. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0063.

19—**Aerojet-General Corp.**, Sacramento, Calif. $14,229,855. Increased level of effort and performance on FY 1970 Mk 56 mine program. Naval Ordnance Systems Command, Washington, D.C. N00017-68-C-1201.

—**General Motors Corp.**, Goleta, Calif. $1,-090,000. Warhead and exploder design for Mk 48 Mod. 1 torpedoes. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-1412.

—**William F. Flingensmith, Inc.**, Rockville, Md. $1,119,700. Construction of an electrical evaluation facility, Naval Air Test Center, Patuxent River, Md. Naval Facilities Engineering Command, Washington, D.C. N62477-68-C-0900.

20—**PRD Electronics, Inc.**, Jericho, N.Y. $2,-314,965 (contract modification). Versatile

Avionics Shop Test (VAST) building blocks and data transfer units. Naval Air Systems Command, Washington, D.C. N00019-68-C-0449.

—**Sanders Associates, Inc.**, Nashua, N.H. $1,970,098 (contract modification). Sonobuoys. Naval Air Systems Command, Washington, D.C. N00019-69-C-0397.

21—**General Electric Co.**, Schenectady, N.Y. $12,275,000. Design and furnishing of nuclear propulsion components. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5154.

—**Westinghouse Electric Corp.**, Washington, D.C. $2,423,018. Gas generators for Poseidon launchers. Sunnyvale, Calif. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0083.

—**E. E. Black, Ltd.**, Honolulu, Hawaii. $1,-141,000. Design and construction of barracks, Fleet Operations Control Center, Kunia, Hawaii. Naval Facilities Engineering Command, Washington, D.C. N62471-69-C-0508.

22—**Westinghouse Electric Corp.**, Pittsburgh, Pa. $40,205,265 (contract modification). Design and furnish nuclear propulsion components. N00024-67-C-5058 Mod 14. $27,713,710. Nuclear propulsion research and development. West Mifflin Borough, Pa. N00024-70-C-5028. $2,455,612. Four Air Search Acquisition Radars and service test models. Friendship International Airport, Baltimore, Md. N00024-70-C-1035.

—**Hahn and Clay Machine and Boiler Works**, Houston, Tex. $2,337,762. Construction of a pressure chamber, Deep Ocean Engineering Pressure Chambers, Naval Ship Research and Development Laboratory, Panama City, Fla. Naval Facilities Engineering Command, Washington, D.C. N62467-69-C-0071.

25—**United Aircraft Corp.**, East Hartford, Conn. $1,800,000 (contract modification). Production of YTF30-P-412 engines, related publications and ground support. Naval Air Systems Command, Washington, D.C. N00019-69-C-0614.

26—**Honeywell Inc.**, St. Petersburg, Fla. $3,656,901. Poseidon inertial components. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0064.

—**Westinghouse Electric Corp.**, Washington, D.C. $2,351,110. Poseidon launcher trainers. Sunnyvale, Calif. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0192.

27—**G. L. Cory, Inc.**, San Diego, Calif. $6,-372,014. Construction of an aircraft surface treatment shop, Naval Air Station, North Island, Calif. Naval Facilities Engineering Command, Washington, D.C. N62473-68-C-0153.

—**Frequency Engineering Laboratories**, Farmingdale, N.J. $1,180,000. Classified electronics equipment. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1432.

28—**Singer-General Precision, Inc.**, Little Falls, N.J. $1,242,920. Components for AN/ASN-41 navigational sets. Naval Aviation Supply Office, Philadelphia, Pa. N00383-70-C-0414.

—**Curtiss Wright Corp.**, Wood-Ridge, N.J. $1,136,251. Spare parts for R1820 engines used on C-1A, EC-1A, E-1A, E-1B and S-2A series aircraft. Naval Aviation Supply Office, Philadelphia, Pa. F41608-69-A-0057.

29—**Lockheed Missile and Space Co.**, Sunnyvale, Calif. $18,000,000. Poseidon missile production. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0092.

—**General Electric Co.**, West Lynn, Mass. $15,900,000 (contract modification). Engineering development of TF-34 turbofan engines for the S-3A aircraft. Naval Air Systems Command, Washington, D.C. N00019-68-C-0443.

—**S and S Contractors, Inc.**, Redmond, Wash. $1,591,066. Construction of 100 units of family housing, Naval Air Station, Whidbey Island, Wash. Naval Facilities Engineering Command, Washington, D.C. N62476-70-C-0029.

—**Sperry Rand Corp.**, St. Paul, Minn. $1,-350,000. Production of digital computer Mk 152 Mods 0, 1 and 2, and associated ancillary equipment for modernization of Tartar and Talos fire control systems (Mk 74 and 77). Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2326.

DEPARTMENT OF THE AIR FORCE

1—**Lockheed-Georgia Corp.**, Marietta, Ga. $80,000,000. Production of C-5A aircraft (Run A). Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33-(657)-15033.

—**United Aircraft Corp.**, East Hartford, Conn. $1,272,870. Production of components applicable to J-57 aircraft engines. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. N383-69000A.

4—**Westinghouse Electric Corp.**, Baltimore, Md. $1,183,803. Spare parts and data applicable to F-4 aircraft radar sets. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F34601-69-A-0034.

—**Aerodex, Inc.**, Miami, Fla. $1,576,745. Overhaul of T56 engines for C-130 aircraft. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F34601-69-D-3989.

—**Kollsman Instrument Corp.**, Elmhurst, N.Y. $1,023,144. Procurement of aerospace ground equipment for AAU-19A aircraft navigational aids. Aeronautical Systems Division, AFSC, Wright-Patterson, AFB, Ohio. AF 33(657)-16524.

—**Bendix Corp.**, Baltimore, Md. $2,330,900. Engineering and logistics services to provide system functional analysis, technical support and computer programming for the AN/FPS-85 phased array radar. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-69-D-0240.

—**Sperry Rand Corp.**, Salt Lake City, Utah. $1,100,000. Procurement of long lead time items for aircraft drones (QU-22B). Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-60-C-0172.

—**Hughes Aircraft Co.**, Fullerton, Calif. $1,393,000. Development of radar equipment in support of the Airborne Warning and Control System. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628-69-C-0054.

5—**Singer-General Precision, Inc.**, San Marcos, Calif. $1,893,385. Electronic components for C-130 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB Okla. F04606-69-A-0134-SD15.

—**General Electric Co.**, Utica, N.Y. $1,-530,000. Electronic countermeasure (ECM) canisters for aircraft, spare parts and aerospace ground equipment, and engineering services and data. Aeronautical Systems Division, AFSC, Wright-Patterson, AFB, Ohio. F33657-70-C-0101.

—**Jet Power, Inc.**, Miami, Fla. $1,677,990. Estimated requirements for the overhaul, repair and modification of gas turbine engines for FY 1970. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-70-D-0320.

6—**Boeing Co.**, Wichita, Kans. $1,645,000. Depot level modification to B-52 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-68-C-4653 P013.

—**Hallicrafters Co.**, Rolling Meadows, Ill. $1,443,000. Aerospace ground equipment for aircraft electronics systems (AN/AAQ-4). Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0470-0002.

—**Wyman-Gordon Co.**, North Grafton, Mass. $2,000,000. Rehabilitation of Bldg. 31, Air Force Plant No. 63, Worcester, Mass. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0147 P001.

—**McDonnell Douglas Corp.**, Long Beach, Calif. $1,400,000. Logistics support for the C-9A aircraft. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-68-C-0001 P013.

—**Lockheed Aircraft Corp.**, Sunnyvale, Calif. $9,000,000. Advance data system for Satellite Control Facility (SCF). Headquarters, Air Force Satellite Control Facility, Los Angeles AFS, Calif. F04695-67-C-0176 P031.

—**General Electric Co.**, Philadelphia, Pa. $2,100,000. Research and development on the Mk 12 reentry vehicle. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. AF 04(694)-975.

7—**Boeing Co.**, Seattle, Wash. $5,857,076. Phase II power/alterations program for Minuteman Wing V. Cheyenne, Wyo. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0142.

8—**General Electric Co.**, West Lynn, Mass. $2,355,000. Production of J-85 turbojet engines for F-5A aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0008-P016.

—**General Electric Co.**, Philadelphia, Pa. $3,400,000. Research and development of the Mk 12 reentry system. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. AF04 (694)-731.

11—**Itek Corp.**, Palo Alto, Calif. $2,628,900. Production of radar receiving equipment for A-7D and F-4E aircraft. Sunnyvale, Calif. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-70-C-3334.

—**Lockheed Aircraft Corp.**, Marietta, Ga. $4,591,211. Procurement of technical data and spare parts for C-5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF33(657)-15053 P00D 300.

—**AVCO Corp.**, Stratford, Conn. $2,000,000. Work on the Mk 11C reentry vehicle. Space and Missile Systems Organization, Los Angeles, Calif. AF04-694-971.

12—**Hercules, Inc.**, Wilmington, Del. $5,155,-900. Production of third stage rocket motors for Minuteman II missiles, plus related data. Magna, Utah. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-70-C-0022.

—**Air Products and Chemicals, Inc.**, Allentown, Pa. $1,812,900. Procurement of liquid oxygen and nitrogen in support of missile and space program testing. Santa Susana, Calif. San Antonio Air Materiel Area, AFLC, Kelley AFB, Tex. F41608-70-D-0284.

13—**Curtiss-Wright Corp.**, Wood-Ridge, N.J. $3,052,901. Production of spare parts for aircraft engines. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-69-A-0057.

—**TRW, Inc.**, Redondo Beach, Calif. $1,-618,400. Research and development, fabrication, launch and orbital support for the VELA satellite program. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04695-67-C-0007.

14—**Aerojet General Corp.**, Sacramento, Calif. $1,207,000. Pre-production effort to support FY 1970 requirements for Stage II Minuteman II motors. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0138.

15—**Hughes Aircraft Co.**, Fullerton, Calif. $1,-610,000. Development of a sensor reporting post, including computer program and related services. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628-69-C-0120.

—**North American Rockwell Corp.**, Tulsa, Okla. $2,431,000. Inspection and repair of Hound Dog air/ground missiles for B-52 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-68-C-0082.

—**Boeing Co.**, Seattle, Wash. $2,075,000. Increment in support of the Safeguard system target test program. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0199.

18—**LTV Electrosystems, Inc.**, Greenville, Tex. $5,263,354. Inspection and repair as necessary of RF-101 aircraft. Greenville, S.C. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-70-C-2330.

19—**TRW, Inc.**, Redondo Beach, Calif. $25,-646,910 (change order to previously awarded contract). Design of satellites and dispensers for the Defense Satellite Communications System. Spece and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0091.

20—**Sylvania Electronic Systems, Inc.**, Waltham, Mass. $2,888,800. Services and supplies in support of the Minuteman ground electronics system. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0229.

—**The Boeing Co.**, Seattle, Wash. $1,937,-500. Installation and check-out of UHF antennas and radios, and refurbishment of launch facilities at Minuteman Wing

VI, Grand Forks AFB, N.D. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0160.

21—RCA, Moorestown, N.J. $1,600,000. Services and material for development, installation and test of equipment to provide pulse compression capability for the AN/FPS-92 radar set. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-69-C-0897.

22—Service Technology Corp., Dallas, Tex. $1,284,000. Increment for changes to conversion of range telemetry systems. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628-C-0195.

25—Lockheed-Georgia Co., Marietta, Ga. $13,337,904. Spare parts for C-5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta Ga. AF33(657)-15053.

—Boeing Co., Wichita, Kan. $2,920,000. Development of an electro-optical viewing system for the B-52 program. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-2487.

—Lockheed-Georgia Co., Marietta, Ga. $2,770,350. Development, activation and operation of a ground data processing system. 2750th Air Base Wing, Wright-Patterson AFB, Ohio. F33600-70-C-0201.

—Kollsman Instrument Corp., Elmhurst, N.Y. $1,150,136. Production of pressure-temperature test sets. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-69-D-9020.

26—Texas Instruments, Inc., Dallas, Tex. $2,170,000. Production of airborne radar, spare parts and related aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1299.

27—Honeywell, Inc. Hopkins, Minn. $10,000,000. Production of BLU 54/B munitions and canisters. St. Louis Park, Minn. Armament Development Test Center, AFSC, Eglin AFB, Fla. F08635-70-C-0001.

—Texas Instruments, Inc., Dallas, Tex. $1,250,000. Engineering effort to test and evaluate the KMU-35 1B guided bomb kit. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1206.

29—Curtiss-Wright Corp., Wood-Ridge, N.J. $5,403,516. Production of spare parts for J-65 aircraft engines. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-69-A-0057.

—Aerodex, Inc., Miami, Fla. $1,447,967. Overhaul of R4360-59B/63A series aircraft engines. San Antonio Air Materiel Area, Kelly AFB, Tex. F41608-69-D-0245.

—AVCO Corp., Stratford, Conn. $2,400,000. Fabrication and testing of Mark 11C Minuteman re-entry vehicles. Space and Missiles Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0242.

—General Electric Co., Philadelphia, Pa. $1,374,000. Research and development of Mark 12 re-entry vehicle. Snace and Missile Systems Organization, AFSC, Los Angeles, Calif. AF04(694)-473.

—General Electric Co., Philadelphia, Pa. $7,342,000. Production of Mark 12 re-entry system. Snace and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0178-P022.

—Aerojet-General Corp., Sacramento, Calif. $3,697,000. Production of stage II motors for Minuteman III. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0138.

Transfer of CIFE

The Office of the Central Index File, Europe (CIFE) has been transferred from the U. S. Mission to the North Atlantic Treaty Organization, and is now under the operational control of the Office of Industrial Security, Defense Supply Agency, Cameron Station, Alexandria, Va.

CIFE is staffed by two industrial security specialists and is located in Brussels, Belgium.

DSA Reports on FY 1969 Activities

The Defense Supply Agency (DSA) procured $5.2 billion of goods and services for the Armed Forces in FY 1969, slightly less than the $5.4 billion total for FY 1968. The gross number of supply requisitions received for DSA-stocked items totaled 20.3 million in FY 1969, an increase over the 19.7 million processed during the previous fiscal year.

DSA, with headquarters at Cameron Station in Alexandria, Va., furnishes supplies and services through a nationwide organization of supply and service centers and depots. It purchases and distributes to the Military Services food, clothing, electronic parts, fuel and petroleum products, medical, chemical, industrial, construction and general supplies. It also performs common services for the Defense Department, such as cataloging, surplus property sales, and the furnishing of research documents. In addition, the full range of DSA-managed material support is furnished to various Federal civil agencies, such as the Coast Guard and the National Aeronautics and Space Administration (NASA).

During FY 1969, DSA assumed responsibility for providing selected packaged petroleum items to all Federal civil agencies and is gradually assuming support of bulk fuel items for these agencies. In September 1969, DSA was given responsibility for supplying all Federal civil agencies with common electronic items.

Along with its procurement responsibilities, the agency provides uniform administration of contracts for supplies and services to the Military Departments, DSA, NASA, and other Federal agencies. At the end of FY 1969, approximately 238,000 prime contracts, valued at $54 billion, were under administration by the Defense Contract Administration Services (DCAS), a major component of the agency. Over $16 billion was paid out by the 11 DCAS regions, which processed 1.8 million contractor invoices.

On a system-wide basis, overall handling of supplies in FY 1969 dropped slightly in volume. The 2,179,000 short tons shipped by DSA compared with 2,317,800 shipped a year earlier. In the same period, DSA received 2,070,000 tons, while 2,081,000 short tons were received the previous year.

The total number of items which DSA centrally manages rose from 1.77 million in FY 1968 to 1.82 million in FY 1969. Customers for these items are the Army, Navy, Air Force, Marine Corps, and civilian agencies of the Government. DSA supply effectiveness, measured by the percentage of requisitions for stocked items filled from on-hand stocks, averaged over 90 percent during FY 1969.

Procurement Totals of Defense Supply Agency Centers

	FY 1968	FY 1969
	(Millions of dollars)	
Defense Construction Supply Center Columbus, Ohio 43215	$ 555.4	$ 608.2
Defense Electronics Supply Center Dayton, Ohio 45401	235.6	198.3
Defense Fuel Supply Center Alexandria, Va. 22314	1,768.2	1,660.0
Defense General Supply Center Richmond, Va. 23219	435.9	511.5
Defense Industrial Supply Center Philadelphia, Pa. 19111	226.0	284.3
Defense Personnel Support Center Philadelphia, Pa. 19101		
Clothing	593.7	677.1
Medical	205.5	203.7
Subsistence	1,185.6	1,188.6

CDC Guides Army Computer Development

As the use of automation increases in the Army, the role of the Directorate of Automatic Data Processing and Management Information Systems (ADP/MIS) also increases. The directorate, part of the Army Combat Developments Command (CDC), Fort Belvoir, Va., has recently been given the job of preparing requirements for, and monitoring of, 15 major automatic data processing (ADP) programs.

The directorate is also responsible for development of combat and combat support automation systems. It aids in the preparation of system automation design and, with other CDC directorates, provides guidance and review to ensure automation programs are compatible with present doctrine.

The idea for an ADP program may come from any element in the Army. A feasibility study is then conducted and, if the nomination passes, a general functional system requirement is prepared for the Department of the Army. Approval by the Department of the Army leads to the development of a detailed functional system requirement.

This detailed paper is an in-depth description of the function to be computerized. From this, the Computer Systems Command then develops the actual hard- and software—the computer system and the programming.

Throughout, CDC provides recommendations and user guidance to ensure that the system meets objectives, and that it will accomplish its functional requirements in the tactical environment.

Major ADP programs involving CDC include:

- CS3. A mobile computerized system for logistical and administrative procedures.
- TACFIRE. The application of ADP techniques to artillery in the field, including fire control, target intelligence and meteorology.
- TOS. The automation of intelligence and other information to aid the field commander in making operational decisions.

Directing ADP/MIS operations is Colonel Charles T. Caprino.

New Ceilometer Developed for USAF Combat Weathermen

Combat weathermen will have a more accurate method of determining cloud heights with a new ceilometer developed by AFSC's Electronic Systems Division, L. G. Hanscom Field, Mass. The ceilometer will be produced by the General Time Corp., Wheeling, Ill., for use by the Air Weather Service.

Compact and rugged, the ceilometer is easily transported and well suited to field use, with potential for paradropping into combat areas. Consisting basically of two units, a projector and a detector, the total weight of the device is 55 pounds. The ceilometer can be set up and used by a two-man crew.

In operation, the projector unit produces a modulated light beam which is directed upward. The light-sensitive detector, located 400 feet from the projector, picks up light signals reflected off the cloud base and relays them back to the projector unit. By reading the strongest beam, the operator can then translate the reading into cloud heights using simple geometry. The ceilometer is effective for cloud heights from 50 to 3,000 feet.

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